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W. J. Gage & Co's. Educational Series.

EXAMINATION PAPERS

IN

ARITHMETIC

DESIGNED FOR USE IN HIGH AND PUBLIC SCHOOLS,
AND ESPECIALLY ADAPTED FOR THE PREPARATION OF CANDIDATES FOR THE VARIOUS
EXAMINATIONS IN ONTARIO.

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NINTH COMPLETE EDITION.

To which is added recent papers set at official examinations in Ontario since the issue of the first edition.

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PREFACE.

THIS work has been prepared at the request of many Teachers and Inspectors, to meet an acknowledged want in connection with the High and Public Schools of this country. It contains all the papers that have been set at the Provincial Examinations since 1871, together with a large number of additional questions, original and selected, some of which have been specially prepared by Mathematical teachers of unquestionable ability. The questions have been arranged in sets, similar in character and about equal in difficulty to those usually given at the various examinations instituted by the Educational Department of Ontario.

This arrangement, it is believed, will be found of great advantage, as affording the best means of intelligent training and the best preparation for the examinations referred to. To be successful at these examinations, students must be trained to a complete independence of the mechanical rules and routine of the ordinary text-books. This independence, with the self-reliance resulting from it, is to be secured, not by solving questions set under given rules and formulas, but by constant practice in properly prepared sets of problems, in which neither rule nor answer is at hand to furnish clews and crutches to the halt and blind. For such practice, abundant materials will be found in the following collection of problems, which is sufficiently large and varied to enable all classes of students to make the necessary preparation for the searching examinations that now form so prominent a feature in the educational system of

Ontario. The work can be used with great *advantage* by all pupils that have mastered the fundamental rules; for such should at once begin to solve PROBLEMS, and write out solutions with a proper regard to neatness and method.

In maintaining the superiority of the "Unitary Method," it is not intended to assert that *rules* should be entirely ignored. On the contrary, rules have their proper place; but the pupil should be the master of the rule, not the rule the master of the pupil. To secure *intellectual training*, independent methods must be followed; but for the sake of *practical facility* in reaching results, rules may be framed as logical inferences from independent investigation. Take for example question 7, page 17; the independent solution leads to an easy practical rule for solving all such questions, *e.g.*: 255 ÷ ·05 = 5100, then *add two* % for the price of the cotton; and (as a similar investigation will show) *subtract three* % for the price of the city property—and so a *general rule* can easily be stated. Of course the results are more easily reached by the rule in this case; but there is little or no intellectual discipline in the application of the *rule*, though there *is* in the investigation which leads to it. The Unitary Method, the general theory of Arithmetic, and the utility and true function of *rules* as formulating the results of independent reasoning, will be found fully treated in the Canadian Edition of Hamblin Smith's Arithmetic.

The Publishers will be glad to receive information as to any errors which may have crept into the work, and to consider any suggestions which may lead to an improvement of a future edition.

TORONTO, April, 1877.

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THE UNITARY SYSTEM.

The Unitary System may be described in general terms as the method of solving arithmetical problems without reference to formal rules. It is so named from the fact that in solving questions by independent analysis, we usually reason from the given elements to **unity**, and from unity to the required result. The *unit*, however, is not necessarily one of the *given* elements; to secure clearness in reasoning, or facility in solution, the required result itself, or any element of the question logically connected with that result, may be taken as the unit of reference. In attaining the two important objects of instruction in arithmetic—valuable intellectual discipline and practical mastery of the subject—the superiority of the Unitary Method over the cumbrous and mechanical processes of the ordinary text-books, will hardly be questioned. These methods are of a purely routine and arbitrary character, tending to induce a "numb rigidity" of intellect, as well as a hazy and all but worthless knowledge of the subject. On the other hand, the Unitary Method, demanding as it does the closest attention and severest exercise of the reasoning faculty, familiarizes the mind with the forms of strict logical inference, and tends to secure that power of continuity of thought which is the very essence of intellectual energy. It is maintained by the greatest scholars and the most successful educators—mathematical and non-mathematical—that arithmetic thus taught affords a logical exercise of the highest value. The student is compelled to set clearly before himself the premises from which he reasons, and to comprehend so thoroughly the necessary connection of the successive steps in the investigation, that he can hardly fail to acquire logical habits of thought and an acute perception of the essence and form of sound reasoning. The great mass of students will never attain, in even a limited extent, these invaluable results, unless the *logical* subjects of the school curriculum are *logically* taught. They have no time to study treatises on formal logic; but so far as truly practical results are concerned, equal benefit may be derived by constant exercise in the common logic of arithmetic—a subject which all must study, and which, taught on the Unitary Method, has been not inaptly designated a veritable **Course of Logic for the People.**

The method will be found equally effective in giving a thorough mastery of the subject. In the attempt to produce intelligent, practical arithmeticians, the old mechanical method has been tried and found wanting. Under its influence students become slaves of rule and formula—not capable of interpreting the formula, and entirely in the dark as to the reasons of the rule. The slave of rules can never have an intelligent command of the subject, and can never be truly practical. He only is truly practical whose knowledge is founded on reasoning which he fully comprehends, and who has been so thoroughly exercised in logical analysis that he is independent of arbitrary rules, and obeys no laws but the necessary laws of strict logical method. Rule-taught "practical" arithmeticians are usually found to be anything but intelligently practical in the solution of practical questions, unless they are charitably told what rule to apply. They apply the rule to the problems given under it; they work mechanically; they walk by a blind faith in the infallibility of the rule-maker; they are mere machines except as to accuracy, in which the machine has the advantage; they become, perhaps expert in the making of figures, which, whatever its value as an exercise of the muscles of the fingers, is absolutely worthless as an exercise of mind. Hence it is that students of this class are utterly bewildered at an examination demanding an intelligent knowledge of the subject, and a moderate power of independent thought; while those trained to habits of strict analysis —taught to reason with mathematical consistency from the known to the unknown—come up to such examinations with a consciousness of power, and a calm self-reliance which are essential to the highest success.

The following solutions will serve to illustrate the simplicity and power of the Unitary Method, as well as its value as a logical exercise. It is believed that those who thoroughly master this chapter, and apply its principles to the solution of the Examination Papers in which they are more especially interested, will have but little difficulty in passing any examination for which they thus faithfully prepare themselves. The solutions, it will be seen, are written out with considerable minuteness, all the successive steps in the reasoning being, in general, given. This is, without doubt, the true course to follow, until familiarity with the method, and considerable power of analysis have been acquired; afterwards, several steps may be combined, and the solution much simplified. Decimal fractions have been but little used, not because they are to be discarded, but because analysis by vulgar fractions is more readily understood. Of course, the pupil is in due time to be taught, for example, that $\frac{1}{20}$ of a quantity may be obtained by multiplying it by ·05; after proper instruction and reasonable practice he will be able to use either vulgar or decimal fractions, as either affords the easier solution of any proposed problem.

Various other solutions of these problems may be given; the *unit* may be varied, or may be obtained in different ways, or by a shorter process; these variations will afford excellent practice for the student, as well as for the teacher who wishes to make himself completely master of the Unitary Method. For example:

If $16 will buy 20 lbs. of tea, what quantity will $40 buy?

If $16 buys 20 lbs.
∴ 1 buys $\frac{20}{16}$ "
And 40 will buy $\frac{20}{16} \times 40$.

If $16 will buy 20 lbs.
∴ $$\frac{16}{20}$ buys 1 lb.
And $$\frac{20}{20}$ (= $1) will buy $1\frac{1}{4}$ lbs.
∴ $40 will buy $1\frac{1}{4} \times 40$.
(Since $\frac{20}{20}$ is $\frac{1}{4}$ more than $\frac{16}{20}$.)

If $16 buys 20 lbs.
∴ $40 will buy $20 \times 2\frac{1}{2}$, since 40 is $2\frac{1}{2}$ times 16.

And so on with any of the following solutions.

THE UNITARY METHOD.

I.—PROPORTION, SIMPLE AND COMPOUND.

1. If 15 barrels of flour cost $111, what will 35 barrels cost?

15 cost 111.

∴ 1 " $\frac{111}{15}$.

and 35 " $\frac{111\times35}{15}=\$259$.

2. If 25 lbs. of tea cost $16, how many lbs. can be bought for $56?

$16 will buy 25.

∴ 1 " $\frac{25}{16}$.

and 56 " $\frac{25}{16}\times56=87\frac{1}{2}$ lbs.

3. If 56 men do a work in 21 days, how long will 24 men require to do it?

Time for 56 men is 21.

∴ " 1 man " 21×56.

and " 24 men " $\frac{21\times56}{24}=49$ days.

4. If the 4 lb. loaf costs 11 cents when flour is $6 a bbl., find its cost when flour is $7½ a bbl.

$6 price demands 11 cents a loaf.

∴ 1 " $\frac{11}{6}$ "

and 7½ " $\frac{11}{6}\times7\frac{1}{2}=13\frac{3}{4}$ cents.

5. A bankrupt owes $3000; his assets are $1740. What sum will a creditor receive whose claim is $350?

On $3000 $1740 is received.

∴ " 1 $\frac{1740}{3000}$ "

and " 350 $\frac{1740}{3000}\times350=\$203$.

6. The expense of carpeting a room was \$100; if the breadth of the room had been 4 ft. greater, the expense would have been \$120. Find the breadth.

\$20 pays for 4 ft. of breadth.
∴ 1 " $\frac{4}{20}$ "
and 100 " $\frac{4}{20} \times 100 = 20$ ft.

7. A man has \$2340 per annum, after paying an income tax of $2\frac{1}{2}$ cents in the dollar; find his gross income.

\$0.97½ is left of \$1 income (*i.e.* after tax is paid).
∴ 1 " $\frac{100}{97\frac{1}{2}}$
and 2340 " $\frac{100}{97\frac{1}{2}} \times 2340 = \frac{200}{195} \times 2340 =$ \$2400.

8. What quantity of carpet 27 in. wide will cover a room 18 ft 6 in. long by 12 feet 4 in. wide?

Room contains $18\frac{1}{2} \times 12\frac{1}{3} = \frac{37 \times 37}{2 \times 3}$ sq. ft.

Since the carpet is $2\frac{1}{4}$ ft. wide, we get
$2\frac{1}{4}$ sq. ft. carpet in 1 ft. length.
∴ 1 " $\frac{1}{2} = \frac{4}{9}$ "
and $\frac{37 \times 37}{2 \times 3}$ " $\frac{4}{9} \times \frac{37 \times 37}{2 \times 3} = 101\frac{11}{27}$ ft.

9. If $\frac{17}{25}$ of a ton of coal cost \$4.25, what will $1\frac{7}{25}$ tons cost?

$\frac{17}{25}$ cost \$4¼.
∴ 1 " $\dfrac{4\frac{1}{4}}{\frac{17}{25}} = \frac{17}{4} \times \frac{25}{17}$.
and $1\frac{7}{25}$ " $\frac{17}{4} \times \frac{25}{17} \times \frac{32}{25} =$ \$8.

10. If 20 men can dig 60 yds. of earth in 4 days, how many yards can 30 men dig in 9 days?

20 men in 4 days dig 60.
1 " 4 " $\frac{60}{20}$.
1 " 1 " $\frac{60}{20 \times 4}$.

80 " 1 " $\frac{60\times30}{20\times4}$.

∴ 80 " 9 " $\frac{60\times30\times9}{20\times4}=202\frac{1}{2}$.

11. If 60 bushels of oats last 6 horses for 50 days, how long will 75 bushels last 15 horses?

6 horses eat 60 bu. in 50 days.

1 " 60 " 50×6.

1 " 1 " $\frac{50\times6}{60}$.

15 " 1 " $\frac{50\times6}{60\times15}$.

and 15 " 75 " $\frac{50\times6\times75}{60\times15}=25$ days.

12. If 120 bushels of oats last 14 horses 56 days, in how many days will 6 horses consume 90 bushels?

14 horses eat 120 bush. in 56 days.

∴ 1 " 1 " $\frac{56\times14}{120}$ days.

and 6 " 90 " $\frac{56\times14\times90}{120\times6}=98$ days

II.—PERCENTAGE, INTEREST, DISCOUNT, PROFIT AND LOSS.

1. A city of 17000 inhabitants increases in a given time to 20,000; find the increase per cent.

Increase on 17000 is 3000.

∴ " 1 " $\frac{3000}{17000}=\frac{3}{17}$.

and " 100 " $\frac{3}{17}\times100=17\frac{11}{17}$.

i. e., " per cent.$=17\frac{11}{17}$.

2. A merchant, after a business of 5 years, found his capital increased to $28000, showing a gain of 60

NOTE.—In questions like 10 and 11, the pupil should be required to give *every step* of the reasoning till he is thoroughly familiar with the method; afterwards he may be allowed to *combine* several of the intermediate steps, as *e. g. Ex.* 12.

per cent on his original capital. Find that capital.

$160 would come from $100 original capital.
∴ 1 " $\frac{100}{160}$ "
and 28000 " $\frac{100}{160} \times 28000 = \$17500$.

3. Required the interest on $300 for 3 years at 7 per cent.

Interest on $100 for 1 year is 7.
" 1 " 1 " $\frac{7}{100}$.
" 1 " 3 " $\frac{7 \times 3}{100}$.
" 300 " 3 " $\frac{7 \times 3}{100} \times 300 = \$63$.

4. If the interest on $264 for 3 years be $63.36, find the rate per cent.

Int. on $264 for 1 year is $21.12.
" 1 " 1 " $\frac{21.12}{264}$.
" 100 " 1 " $\frac{21.12}{264} \times 100 = 8$.

5. What principal will produce $60 in 219 days, at 7½ per cent. per annum?

Principal to give 7½ in 365 days is 100.
" 1 " 1 " $\frac{100 \times 365}{7\frac{1}{2}}$.
" 60 " 1 " $\frac{100 \times 365 \times 60}{7\frac{1}{2}}$.
" 60 " 219 " $\frac{100 \times 365 \times 60}{7\frac{1}{2} \times 219} = \$1333\frac{1}{3}$.

6. In what time will $400 amount to $425 at 5 per cent. per annum?

Int.=425—400=25. 400 produces 20 in 1 year, then,
Time to produce $20 is 1 year.
" 1 " $\frac{1}{20}$ "
" 25 " $\frac{1}{20} \times 25 = 1\frac{1}{4}$.

7. Find the discount on $240 for 2 years at 7 per cent.

Int. on 100 for given time and rate = $14.
∴ $114 gives 14 discount.

1 " $\frac{14}{114}$.
and 240 " $\frac{14}{114} \times 240 = \$29\frac{9}{19}$.

8. A dealer bought an article on 4 months' credit for $23.75, and sold it forthwith at $25.50, on such an allowance of credit as made his gain $6\frac{2}{3}$%. How long credit did he give, reckoning interest at 5% per annum?

Pres. worth of $101\frac{2}{3}$ is 100 (*i.e.* ∵ interest on 100 for 4mo=$1\frac{2}{3}$.)
" 1 " $100 \div 102\frac{2}{3}$.
and ∴ " 23.75 " $23\frac{22}{61}$ = *actual* cost of the article. Again,

Gain on $23\frac{22}{61}$ at $6\frac{2}{3}\% = 1\frac{34}{61}$;
∴ $23\frac{22}{61} + 1\frac{34}{61} = 24\frac{56}{61}$ = *actual* selling price;
∴ $25\frac{1}{2} - 24\frac{56}{61} = \frac{71}{122}$ = loss by credit.

Hence, what time must $24\frac{56}{61}$ be lent to produce $\frac{71}{122}$?

5 is interest on 100 for 1 year.
$\frac{5}{100}$ " " 1 " 1 "
$\frac{5}{100} \times 24\frac{56}{61}$ " $24\frac{56}{61}$ " 1 "
∴ 1 " $24\frac{56}{61}$ " $1 \div (\frac{5}{100} \times 24\frac{56}{61})$ years.
and $\frac{71}{122}$ " " " $\frac{100 \times 61 \times 71}{5 \times 1520 \times 122} = \frac{71}{152}$ years.

9. Find the amount (compound interest) of $3000 for 3 years at 10% per annum.

Amt. of 1 for 1 year is $1 + \frac{1}{10}$.
" 1 " 2 " $(1+\frac{1}{10}) + \frac{1}{10}(1+\frac{1}{10}) = (1+\frac{1}{10})^2$.
" 1 " 3 " $(1+\frac{1}{10})^2 + \frac{1}{10}(1+\frac{1}{10})^2$.
$= \{1+\frac{1}{10}\}^2 \{1+\frac{1}{10}\} = (1+\frac{1}{10})^3$,
∴ " 3000 " 3 " $(1+\frac{1}{10})^3 \times 3000 = \$3993$.

10. Tea is bought at 84 cents per lb., and sold at 98 cents, find gain %.

84 gains 14.
1 “ $\frac{14}{84}$.
100 “ $\frac{14}{84}\times 100=16\frac{2}{3}$.

11. Certain books are bought at $1.75 each. At what must they be sold to gain 12% ?

100 sells for 112.
1 “ $\frac{112}{100}$.
1·75 “ $\frac{112}{100}\times\frac{7}{4}=\$1.96$.

12. Eggs are sold at the rate of 5 for 6 cents, a profit of 20% being made. Find the price at which they are bought.

120 cts. is received on 100 cts. cost.
1 “ $\frac{100}{120}$ “
6 “ $\frac{100}{120}\times 6=5$, or one cent each.

13. Flour is sold for $6 a bbl., at a loss of 17%; find what selling price would give 16%.

Sold at 17% loss, *i.e.*, 100 sold for 83.
To gain 16% 100 should sell for 116; hence
$83 must bring 116.
1 “ $\frac{116}{83}$.
6 “ $\frac{116}{83}\times 6=8\frac{32}{83}$.

14. If 3% more be gained by selling a horse for $333 than by selling him for $324, find his original price.

333−324=9 increase.
3% gain from increase of 9.
∴ 1 “ “ 3.
and 100 “ “ 300, which was ∴ the price.

III.—PROPORTIONAL PARTS, PARTNERSHIP, CHAIN RULE, EXCHANGE, ALLIGATION.

1. Divide $600 among A, B and C in the ratio of 3, 4, 5.

3 + 4 + 5 = 12, therefore

of \$12,	A gets 3,		B	4,	C	5.
" 1,	"	$\frac{3}{12}$,	"	$\frac{4}{12}$,	"	$\frac{5}{12}$.
" 600,	"	$\frac{3}{12} \times 600$	"	$\frac{4}{12} \times 600$	"	$\frac{5}{12} \times 600$
		$= 150$,		200,		250.

2. A bankrupt owes three creditors $620, $470 and $380 respectively; his assets amount to $588. Find each man's share.

620 + 470 + 380 = 1470.

A debt of \$1470 is discharged with \$588.

∴	" 1	"	$\frac{588}{1470} = \frac{2}{5}$.
	and 620	"	$\frac{2}{5} \times 620 = 248$.
	470	"	$\frac{2}{5} \times 470 = 188$.
	380	"	$\frac{2}{5} \times 380 = 152$.

3. Divide $930 among A, B, C, and D, so that A's share may be to B's as 2:3, B's to C's as 4:5, and C's to D's as 3:5.

Take A's share as the *unit*; A's is to B's as 2:3, *i. e.* B's $= \frac{3}{2}$ A's; B's is to C's as 4:5, *i. e.* C's $= \frac{5}{4}$ B's; C's is to D's as 3:5, *i. e.* D's $= \frac{5}{3}$ C's.

A's is 1.
B's " $\frac{3}{2}$.
C's " $\frac{5}{4}$ B's $= \frac{5}{4} \times \frac{3}{2} = \frac{15}{8}$.
D's " $\frac{5}{3}$ C's $= \frac{5}{3} \times \frac{15}{8} = \frac{25}{8}$.

∴ *All* the shares $= 1 + \frac{3}{2} + \frac{15}{8} + \frac{25}{8} = 7\frac{1}{2}$ times A's share.

$7\frac{1}{2}$ times A's = 930.

A's $= 930 \div 7\frac{1}{2} = 124$, B's $= \frac{3}{2} \times 124 = 186$.

C's $= \frac{5}{4} \times 186 = 232.50$, D's $= \frac{5}{3} \times 232.50 = 387.50$.

4. A and B join in business; A puts in $700 for 12 months, and B $500 for 18 months. Divide a profit of $1805 equitably between them.

700 for 12 months = 8400 for one month.
500 " 18 " = 9000 "

The profits must therefore be divided in the ratio of 84:90=14:15. 14+15=29.

Of 29, A gets 14, B 15.

∴ " 1 " $\frac{14}{29}$, " $\frac{15}{29}$.

and " 1305 " $\frac{14}{29}\times 1305$ " $\frac{15}{29}\times 1305$.

or, A's=630, B's=675.

5. Two merchants, A and B, engaged in business, with capitals in the ratio of 5 to 7; at the end of 5 months they withdrew $\frac{1}{5}$ and $\frac{1}{6}$ of their capitals respectively. Divide fairly between them the year's profits of $3092.

Take A's capital as the *unit*. B's=$\frac{7}{5}$ A's.

Then A has 1 for 5 months+$\frac{4}{5}$ for 7 months=$10\frac{3}{5}$ for one month.

B has $\frac{7}{5}$ for 5 months+($\frac{7}{5}-\frac{1}{6}$ of $\frac{7}{5}$) for 7 months=$15\frac{1}{6}$ for one month.

Which numbers give the ratio in which the profits are to be divided.

$10\frac{3}{5}:15\frac{1}{6}$=318:455. 318+455=773.

Of 773 A gets 318, B gets 455.

" 1 " $\frac{318}{773}$, " $\frac{455}{773}$.

∴ "3092 " $\frac{318}{773}\times 3092$, " $\frac{455}{773}\times 3092$.

or, A's=1272, B's=1820.

6. In a certain constituency the total number of votes was 1800; in an election of a member for the Legislature the votes polled by the candidates were in the ratio of 8 to 5, and the winning candidate had a majority of 369. How many voters did not go to the poll?

The winning man had a
majority of 3 in 13 votes polled.

∴ " 1 " $\frac{13}{3}$ "

and " 369 " $\frac{13}{3}\times 369$=1599—total polled.

$\therefore$ 1800−1599=201 not polled.

7. A and B are partners in trade; A contributes 40% of the joint capital for $10\frac{1}{2}$ months, and B receives $\frac{3}{5}$ of the gain. Find A's period of investment.

40%$=\frac{2}{5}$; $\frac{2}{5}$ for $10\frac{1}{2}$ months$=\frac{21}{5}$ for 1 month.

Profit of $\frac{2}{5}$ arises from $\frac{21}{5}$ for 1 month.

$\therefore$ " $\frac{1}{5}$ " $\frac{7}{5}$ "

and " $\frac{3}{5}$ " 7 " which is the product of B's stock by time of investment; but B's stock is $\frac{3}{5}$ of whole capital, $\therefore 7\div\frac{3}{5}=11\frac{2}{3}$ B's *time.*

8. If 4 lbs. of tea be worth 40 lbs. of sugar, and 8 lbs. of sugar be worth $1\frac{1}{2}$ lbs. of coffee, and 3 lbs. of coffee be worth 12 lbs. of biscuits, how many lbs. of biscuits are worth 168 lbs. of tea?

1 lb. tea = 10 lb. sugar.
1 lb. sug. = $\frac{3}{16}$ lb. coffee.
1 lb. coffee = 4 lb. biscuits.
1 lb. tea = $10\times\frac{3}{16}\times4$.
and 168 lb. " = $10\times\frac{3}{16}\times4\times168=1260$.

9. The exchange between London and Frankfort is 11 florins 52 kreutzers for the £ sterling; the exchange between Paris and Frankfort is 20 francs for 9 florins 20 kreutzers. What is the exchange between London and Paris, taking a florin as equal to 60 kreutzers.

$9\frac{1}{3}$ florins=20 francs, $\therefore$ 1 florin$=\frac{20}{9\frac{1}{3}}=\frac{15}{7}$ francs.
Also, $11\frac{52}{60}$ florins=£1, $\therefore$ 1 florin=£1$\div11\frac{52}{60}=$£$\frac{15}{178}$.
Hence £$\frac{15}{178}=\frac{15}{7}$ francs.
$\therefore$ £1$=\frac{15}{7}\times\frac{178}{15}=25\frac{3}{7}$ francs.

10. Calculate the ratio between the values of gold and silver, it being given that 2 lbs. of standard gold are coined into 89 guineas, and 1 lb. of standard silver is coined into 66 shillings, and that $\frac{1}{12}$ of standard gold and $\frac{3}{40}$ of standard silver are alloy.

Here 11 lbs. pure gold=12 lbs. standard, and 37 lbs. pure silver=40 lbs. standard; we have, therefore,

1 lb. pure gold$=\frac{12}{11}$ st. gold.
1 lb. st. " $=\frac{89\times21}{2}$ shillings.
1 shilling $=\frac{1}{66}$ lb. st. silver.
1 lb. st. silver $=\frac{37}{40}$ lb. pure silver.
∴ 1 lb. pure gold$=\frac{12}{11}\times\frac{89\times21}{2}\times\frac{1}{66}\times\frac{37}{40}=14\frac{1393}{4840}$ lbs. pure silver.

11. A merchant in Montreal owes another in Lisbon 1623⅜ milrees, and he resolves to remit through London, Amsterdam and Paris; exchange between Montreal and London is at 9½%; between London and Amsterdam, £1 sterling for £1$\frac{35}{39}$ Flemish; between Amsterdam and Paris, £1 Flemish for 13 francs; and between Paris and Lisbon, 3 francs per 450 rees. If the expenses of this circuitous course be 2½ per cent., what will it cost the Montreal merchant to settle his Lisbon account? (1000 rees=1 milree.)

Since stg. exchange is 9½, ∴ £9=\$40 (1.095). Also, 3 francs=450 rees$=\frac{450}{1000}=\frac{9}{20}$ milrees, we have. therefore,

1 Milree $=\frac{20}{3}$ francs.
1 Franc $=\frac{1}{13}$ Flem. £.
1 Flem. £. $=\frac{39}{74}$ Eng. £.
1 Eng. £. = 40 × 1.095 dollars debt.
\$1 debt $=\frac{100}{97\frac{1}{2}}=\$\frac{40}{39}$ actually paid (since expense = 2½%, or 97½ debt. is paid with 100).
∴ 1623⅜ Milrees $=\frac{20}{3}\times\frac{1}{13}\times\frac{39}{74}\times\frac{40\times1.095}{9}\times\frac{12987}{8}\times\frac{40}{39}$ = 2190.

12. How much sugar worth 5 cts., 7 cts., 12 cts., 13 cts. per lb. will form a mixture worth 10 cts.

By selling at the average price (10) we have

5 cts. gain on 1 lb. @ 5 ∴ 1 ct. *gain* on $\frac{1}{5}$ lb.
3 cts. gain on 1 lb. @ 7 ∴ 1 ct. *gain* on $\frac{1}{3}$ lb.
2 cts. loss on 1 lb. @ 12 ∴ 1 ct. *loss* on $\frac{1}{2}$ lb.
3 cts. loss on 1 lb. @ 13 ∴ 1 ct. *loss* on $\frac{1}{3}$ lb.

And with every cent *gain* we must take a cent *loss*, hence we have

$$\left.\begin{matrix}\frac{1}{5} @ 5\\ \frac{1}{2} @ 12\\ \frac{1}{3} @ 7\\ \frac{1}{3} @ 13\end{matrix}\right\} = \left\{\begin{matrix}2 @ 5.\\ 5 @ 12.\\ 1 @ 7.\\ 1 @ 13.\end{matrix}\right.$$

We may also combine *gains* and *losses* thus:

$$\left.\begin{matrix}\frac{1}{5} @ 5\\ \frac{1}{3} @ 13\\ \frac{1}{3} @ 7\\ \frac{1}{2} @ 12\end{matrix}\right\} = \left\{\begin{matrix}3 @ 5.\\ 5 @ 13.\\ 2 @ 7.\\ 3 @ 12.\end{matrix}\right.$$

13. How much sugar worth 10 cts., 13 cts., 15 cts., 17 cts., and 18 cts., will make a mixture worth 16 cts.?

6 cts. gain on 1 lb. @ 10, ∴ 1 ct. *gain* on $\frac{1}{6}$ lb.
3 " gain on 1 lb. @ 13, ∴ 1 ct. *gain* on $\frac{1}{3}$ lb.
1 " gain on 1 lb. @ 15, ∴ 1 ct. *gain* on 1 lb.
1 " loss on 1 lb. @ 17, ∴ 1 ct. *loss* on 1 lb.
2 " loss on 1 lb. @ 18, ∴ 1 ct. *loss* on $\frac{1}{2}$ lb.

Each cent *gain* must be balanced by a cent *loss*, and hence one of the losses (it is immaterial which) must be taken *twice*.

$$\therefore \text{we have} \left.\begin{matrix}\frac{1}{6} @ 10\\ \frac{1}{3} @ 13\\ 1 @ 15\\ 1 @ 17\\ 1 @ 18\end{matrix}\right\} \text{or} \begin{matrix}1 \text{ at } 10.\\ 2 \text{ `` } 13.\\ 6 \text{ `` } 15.\\ 6 \text{ `` } 17.\\ 6 \text{ `` } 18.\end{matrix}$$

Any gain* may be combined with *any loss*; *e. g.

$\left.\begin{matrix}\frac{1}{6} \text{ @ } 10\\ \frac{1}{2} \text{ @ } 18\end{matrix}\right\}=\frac{1}{3}$; $\left.\begin{matrix}\frac{1}{3} \text{ @ } 13\\ 1 \text{ @ } 17\end{matrix}\right\}=\frac{1}{3}$; $\begin{matrix}1 \text{ @ } 15.\\ 1 \text{ @ } 17.\end{matrix}$

∴ we have 1 @ 10.
1 @ 13.
1 @ 15.
4 @ 17.
3 @ 18.

They may, of course, be combined in various other ways, giving, for example:

1 @ 10	3 @ 10	2 @ 10	1 @ 10
2 @ 13	3 @ 13	1 @ 13	3 @ 13
1 @ 15	3 @ 15	3 @ 15	2 @ 15
7 @ 17	10 @ 17	4 @ 17	9 @ 17
3 @ 18	10 @ 18	7 @ 18	4 @ 18

From an examination of the above analysis, may be deduced a very simple and convenient *practical* rule, which will be given in the Canadian Edition of Hamblin Smith's Arithmetic.

IV.—COMMISSION, INSURANCE, ETC., STOCKS.

1. An agent received $40.62½ for selling a house worth $1625; find his rate per cent. of commission.

$1625 gives $40.62½.
∴ 1 " $\frac{40.62\frac{1}{2}}{1625}$.
And 100 " $\frac{40.62\frac{1}{2}}{1625}\times 100=2\frac{1}{2}$.

2. A broker received $46.50 for buying stock on a commission of ⅝ per cent.; how much stock did he buy?

Com. of ⅝ received on 100.
∴ 1 " $100\div\frac{5}{8}=160$.
And 46.50 " $160\times 46\frac{1}{2}=7440$.

3. A merchant in Toronto sends a commission merchant in Montreal $3120, instructing him to purchase goods, reserving his commission at 4 per cent.; find his commission.

On \$104 he gets \$4 commission.

∴ " 1 " $\frac{4}{104}=\frac{1}{26}$.

And " 3120 " $\frac{1}{26}\times 3120=120$.

4. For what amount must property worth \$7600 be insured, at 5 per cent., so that in case of loss both the premium and the value of the goods may be recovered?

To realize 95 we must insure 100 (Since 5 is paid in premium.)

" 1 " $\frac{100}{95}=\frac{20}{19}$.

" 7600 " $\frac{20}{19}\times 7600=8000$.

5. A man allows his agent 5 % for collecting his rents; he spends $14\frac{2}{7}$ % of the remainder in insuring his life, and this part is exempt from income tax; his income tax at $4\frac{1}{6}$ % is \$77.90; find his gross income.

$5\,\%=\frac{1}{20}$, $14\frac{2}{7}\,\%=\frac{1}{7}$, $4\frac{1}{6}\,\%=\frac{1}{24}$. Take gross income as the *unit*.

Then, $1-\frac{1}{20}=\frac{19}{20}$ net income, $\frac{1}{7}$ of which is paid to insure life; the remainder is ∴ $\frac{6}{7}\times\frac{19}{20}=\frac{57}{70}$, of which $\frac{1}{24}$ is paid in income tax, ∴ $\frac{57}{70}\times\frac{1}{24}=\$77.90$.

and $1=\$77.90\times\frac{70}{57}\times\frac{24}{1}=\$2296$.

6. A company took a risk at $1\frac{1}{4}$ %, and immediately re-insured $\frac{4}{5}$ of it at $1\frac{3}{4}$ %, paying on *this* \$15 more than was received for the entire risk; find the amount of the risk.

$1\frac{1}{4}\,\%=\frac{5}{400}=\frac{1}{80}$, $1\frac{3}{4}\,\%=\frac{7}{400}$: Take the amount of the risk as the *unit*; then

$\frac{1}{80}$ was *received*; and since $\frac{4}{5}$ of risk was re-insured

∴ $\frac{4}{5}\times\frac{7}{400}=\frac{7}{500}$ was *paid*; and

$\frac{7}{500}-\frac{1}{80}=\frac{3}{2000}$ which is $=\$15$;

∴ 1 (=risk)$=\$15\times\frac{2000}{3}=\$10000$.

7. Having sold a consignment of cotton on 3 % commission, I am instructed to invest the proceeds in city property, reserving a commission of 2 % on the price paid for the property; my whole commission being \$265, find

the amount for which the cotton sold.

Take this amount for the *unit*, then

$\frac{3}{100}$ = first com. $\frac{97}{100}$ left.

On 102 is received 2 com. (2nd transaction).

∴ 1 " $\frac{2}{102} = \frac{1}{51}$, hence com. on *property*
$= \frac{1}{51} \times \frac{97}{100} = \frac{97}{5100}$.

∴ entire commission $= \frac{3}{100} + \frac{97}{5100} = \frac{5}{102}$.

But $\frac{5}{102}$ = $265.

∴ $\frac{1}{102}$ = $53.

And 1 = $53 × 102 = $5406.

8. What sum must be assessed to raise $12250, the collector's commission being 2 per cent?

98 is raised from 100 (the collector getting 2).

∴ 1 " $\frac{100}{98} = \frac{50}{49}$.

And 12250 " $\frac{50}{49} \times 12250$=$12500.

9. What income will a man realize from investing £5,000 in the 3½ per cents at 87½?

87½ brings 3½ income.

∴ 1 " $3\frac{1}{2} \div 87\frac{1}{2} = \frac{1}{25}$.

And 5000 " $\frac{1}{25} \times 5000$=£200.

10. When the 3½ per cents are at 98, what must be the price of another stock yielding 4½ per cent., so that the latter may be as profitable as the former?

3½ is received from 98.

∴ 1 " " $\frac{98}{3\frac{1}{2}}$.

And 4½ " " $\frac{98}{3\frac{1}{2}} \times 4\frac{1}{2} = 126$.

11. Which is the more profitable investment, Dominion Bank stock at 112¼ and paying 3¾ % half yearly dividends, or Bank of Commerce stock at 119¼ and paying half-yearly dividends of 4¼ per cent.?

In the 1st 112¼ brings 3¾ dividend,

∴ 1 " $3\frac{3}{4} \div 112\frac{1}{4} = \frac{15}{449}$,

" 2nd 119¼ " 4¼ dividend,

∴ 1 " $4\frac{1}{2} \div 119\frac{1}{2} = \frac{9}{239}$.

Now make the *numerators* equal,

$\frac{15}{489} = \frac{45}{1467}$, and $\frac{9}{239} = \frac{45}{1195}$:

the latter is ∴ the better investment.

12. A sum of money is invested in 6 % stock at $89\frac{3}{8}$, and a half year's dividend received on it; the stock being then sold at $94\frac{5}{8}$, and the whole increase of capital being $\$148\frac{1}{2}$, find the original sum invested.

Half year's dividend on $89\frac{3}{8} = 3$.

$94\frac{5}{8} - 89\frac{3}{8} = 5\frac{1}{4}$ ∴ whole increase on $89\frac{3}{8} = 8\frac{1}{4}$.

$8\frac{1}{4}$ increase from $89\frac{3}{8}$,

∴ 1 " $89\frac{3}{8} \div 8\frac{1}{4} = \frac{65}{6}$.

And $148\frac{1}{2}$ " $\frac{65}{6} \times 148\frac{1}{2} = 1608\frac{3}{4}$.

13. A person invests a certain sum (U. S. currency) in U. S. 5's-10-40 (*i.e.*, certain bonds paying 5 per cent.), and $70\frac{10}{19}$ per cent. more than that sum in U. S. 6's 5-20, the former being at a discount of 5 per cent., and the latter at a premium of 8 per cent., and the interest on both payable in gold. His income from the two investments is $1400 in gold. Find the amount, currency, invested in each kind of bonds.

$70\frac{10}{19}\,\% = \frac{67}{95}$ ∴ for every unit of the first investment there is $1\frac{67}{95} = \frac{162}{95}$ of the second. Since the first is at discount of 5, 95 brings 5 income.

∴ 1 " $\frac{5}{95}$. So in 2nd investment.

108 " 6.

∴ 1 " $\frac{6}{108}$.

And $\frac{162}{95}$ " $\frac{6}{108} \times \frac{162}{95} = \frac{9}{95}$.

∴ $\frac{5}{95} : \frac{9}{95} = 5$ to 9, is the ratio in which the whole gain is to be assigned to the two investments; $1400 thus divided gives $500 for first, $900 for second.

Then, $\frac{1}{19}$ unit of income arises from 1 unit of investment.

∴ 1 " 19 "
and 500 " $19 \times 500 = 9500$; and in the second case,

$\frac{1}{18}$ unit of income arises from 1 unit of investment.

∴ 1 " 18 "
and 900 " $18 \times 900 = 16200$.

14. A person investing in 6% bank stock received $6\frac{9}{16}$ per cent. on his investment; find the price of the stock.

$6\frac{9}{16}$ received on 100.
∴ 1 " $100 \div 6\frac{9}{16} = \frac{320}{21}$.
and 6 " $\frac{320}{21} \times 6 = 91\frac{3}{7}$.

15. A man deriving all his income from an investment in railway stock paying 6%, spends during the first year $\frac{2}{3}$ of his income in personal expenses, and besides pays an income tax on his gross income of $2\frac{1}{2}$ cts. in the dollar; the second year the railway dividends are $7\frac{1}{2}$ per cent., his personal expenses are increased $12\frac{1}{2}$ per cent., and the income tax is reduced to two cents in the dollar; his savings for the second year being \$200 greater than for the first, find his first year's income.

Take original income as *unit* of reference. $2\frac{1}{2}\% = \frac{1}{40}$. The first year he spends $\frac{2}{3} + \frac{1}{40} = \frac{83}{120}$, and ∴ saves $\frac{37}{120}$. The 2nd year his gross income is 25% $(=\frac{1}{4})$ more than 1st year $= \frac{5}{4}$.

His personal expenses $= \frac{2}{3} + 12\frac{1}{2}\%$ of $\frac{2}{3} = \frac{3}{4}$.
His income tax $= 2\%$ of $\frac{5}{4} = \frac{1}{50}$ of $\frac{5}{4}$ $= \frac{1}{40}$.
∴ his total outlay $= \frac{3}{4} + \frac{1}{40}$ $= \frac{31}{40}$.
" saving $= \frac{4}{5} - \frac{31}{40}$ $= \frac{19}{40}$.
∴ difference between the two savings $= \frac{19}{40} - \frac{37}{120} = \frac{1}{6} =$ \$200, and 1 = \$1200 = original income.

16. How much currency is required to purchase U. S. 5% bonds, interest payable in gold, to yield an income of \$795 in currency, gold being at a premium of 6%, and the broker's commission being $\frac{1}{4}$% on the par value of the bonds?

100 gold=106 currency.
∴ 1 " $=\frac{106}{100}=\frac{53}{50}$.
and 5 " $=\frac{53}{50}\times 5=\frac{53}{10}$ income % in currency.
$\frac{53}{10}$ income from 100 bonds.
∴ 1 " $100\div\frac{53}{10}=100\times\frac{10}{53}$.
and 795 " $100\div\frac{10}{53}\times 795=15000$ in bonds, on which $\frac{1}{4}$% has to be paid.
100 gives $\frac{1}{4}$.
1 " $\frac{1}{4}\div 100$.
15000 " $\frac{1}{400}\times 15000=37\frac{1}{2}$.
∴ whole amount required=15037.50

V.—MISCELLANEOUS PROBLEMS.

1. A can do a piece of work in 3 days, B in 4 days, and C in 8 days; in what time will all working together do it?

A does $\frac{1}{3}$ of the work in 1 day, B $\frac{1}{4}$, and C $\frac{1}{8}$.
∴ *All* do $\frac{1}{3}+\frac{1}{4}+\frac{1}{8}$ in 1 day.
$=\frac{8+6+3}{24}=\frac{17}{24}$ " .
∴ $\frac{1}{24}$ in $\frac{1}{17}$ day,
and 1 in $\frac{1}{17}\times 24=1\frac{7}{24}$.

2. A man engages to do a piece of work in 20 days for \$30; after doing $\frac{2}{3}$ of it in $15\frac{1}{3}$ days, he finds he cannot complete it in the time, and he gets the assistance of another workman, and they together finish it in the allotted time. How long would the second man take to do the whole work, and how ought the \$30 to be divided between them?

A does $\frac{2}{3}$ of the work in $15\frac{1}{3}$ days.

$\therefore \frac{1}{3}$ " $\frac{15\frac{1}{3}}{2}$.

and 1 " $\frac{15\frac{1}{3}}{2} \times 3 = 23$.

$\frac{2}{3}$ was done in $15\frac{1}{3}$ days. $\frac{1}{3}$ has to be done in the remaining $4\frac{2}{3}$ days.

In 1 day A does $\frac{1}{23}$.

$\therefore 4\frac{2}{3}$ " $\frac{1}{23} \times 4\frac{2}{3} = \frac{14}{69}$; hence

$\frac{1}{3} - \frac{14}{69} = \frac{9}{69} = \frac{3}{23}$, what B does in $4\frac{2}{3}$ days.

$\therefore \frac{1}{23}$ in $4\frac{2}{3} \div 3$.

and 1 in $\frac{14}{9} \times 23 = 35\frac{7}{9}$.

Since B does $\frac{3}{23}$ of the work he is entitled to $\frac{3}{23}$ of \$30 $= \$3.91\frac{7}{23}$.

and A's share is $\therefore 30 - 3.91\frac{7}{23} = 26.08\frac{16}{23}$.

3. To do a certain piece of work B would take twice as long as A and C together, and C twice as long as A and B together; and A, B, and C together actually do it in 5 days; \$60 is paid for the work; divide this fairly among them.

A, B, and C do $\frac{1}{5}$ in one day, and since A and C together take *half* the time required by B, they do *twice* as much in a given time, ∴ A's work + C's = 2 B's;

∴ B's day's work + 2 B's day's work = 3 B's day's work $= \frac{1}{5}$.

∴ B does the work in 15 days. Again,

A and B do the work in *one-third* C's time, *i.e.*, they do three times as much as C in given time.

∴ C's day's work + 3 C's day's work = 4 C's day's work $= \frac{1}{5}$.

∴ C does the work in 20 days; and

$\frac{1}{5} - (\frac{1}{15} + \frac{1}{20}) = \frac{1}{12} =$ A's day's work.

∴ A does it in 12 days. Finally,

A does $\frac{1}{12}$, B $\frac{1}{15}$, C $\frac{1}{20}$ in 1 day.

∴ " $\frac{5}{12}$, " $\frac{5}{15}$, " $\frac{5}{20}$ in 5 days.
And A's share$=\frac{5}{12}\times 60=25$.
B's share$=\frac{5}{15}\times 60=20$.
C's share$=\frac{5}{20}\times 60=15$.

4. If 3 men and 4 women could do a piece of work in $1\frac{11}{19}$ days, and 5 men and 3 women could do the same work in $1\frac{1}{3}$ days, and 1 man and 1 woman actually do the work, divide $20, the price paid for it, equitably between them.

In $1\frac{11}{19}$ days 3 m. and 4 w. do the work.
∴ " 1 " " " $\frac{19}{30}$ "
And " 1 " 1 m. and $\frac{4}{3}$ w. do $\frac{19}{90}$ " Also,
In $\frac{4}{3}$ days 5 men and 3 w. do the work.
∴ " 1 " 5 " 3 w. do $\frac{3}{4}$ "
And " 1 " 1 " $\frac{3}{5}$ w. do $\frac{3}{20}$ "
∴ $\frac{4}{3}$ woman's day's work $-\frac{3}{5}$ do.$=\frac{19}{90}-\frac{3}{20}=\frac{11}{180}$. Hence
$\frac{11}{180}$ of the work$=\frac{11}{15}$ woman's day's work.
$\frac{1}{180}$ " $=\frac{1}{15}$ " "
1 " $=\frac{1}{15}\times 180=12$. Hence
1 man's and $\frac{4}{3}$ woman's day's work$=\frac{19}{90}$ of the work,
i.e. 1 " $+\frac{4}{3}$ of $\frac{1}{12}=\frac{19}{90}$.
∴ 1 " $=\frac{19}{90}-\frac{1}{9}=\frac{1}{10}$; ∴ 10 days for one man.
One man does the work in 10 days,
One woman " 12 "
∴ 12 to 10=6 to 5 is ratio of the man's share of money to the woman's share:
Of 11 the man gets 6, the woman 5.
∴ " 1 " $\frac{6}{11}$ " $\frac{5}{11}$.
And " 20 " $\frac{120}{11}=10\frac{10}{11}$ " $\frac{100}{11}=9\frac{1}{11}$.

5. Some smugglers found a cave which would exactly hold the cargo of their boat, viz., 13 bales of silk, and 33 casks of rum; while unloading, a revenue cutter came in sight, and they were obliged to sail away, hav-

only 5 bales and 9 casks, which filled $\frac{1}{3}$ of the ow many bales separately, and how many would fill the cave?

13 bales + 33 casks fill the cave.

$\therefore$ 1 " + $\frac{33}{13}$ " $\frac{1}{13}$ "   Also,

5 " + 9 " $\frac{1}{3}$ "

$\therefore$ 1 " + $\frac{9}{5}$ " $\frac{1}{15}$ "

hence $\frac{33}{13}-\frac{9}{5}=\frac{48}{65}$ cask occupies $\frac{1}{13}-\frac{1}{15}=\frac{2}{195}$ of cave.

$\therefore$ 1 " $\frac{2}{195}+\frac{48}{65}=\frac{1}{72}$.

$\therefore$ 72 casks are required.

Then 1 bale + $\frac{9}{5}$ cask occupy $\frac{1}{15}$ of cave,

i.e., 1 bale + $\frac{9}{5}\times\frac{1}{72}$ (= $\frac{1}{40}$) of cave equal $\frac{1}{15}$ of cave.

Or 1 bale occupies $(\frac{1}{15}-\frac{1}{40})=\frac{1}{24}$ of cave,

$\therefore$ 24 bales are required.

4. If 14 oxen eat 2 acres of grass in 8 weeks, and 16 oxen eat 6 acres in 9 weeks, how many oxen will eat 24 acres in 6 weeks, the grass being at first equal on every acre, and growing uniformly?

Growth must be taken into account; and in 1st case the growth on 2 ac. for 8 weeks = growth on 6 ac. for one week; in 2nd case the growth on 6 ac. for 9 weeks = growth on 54 ac. for 1 week; and in 3rd case, the growth on 24 ac. in 6 weeks = growth on 144 ac. for 1 week.

14 oxen in 8 weeks eat 2 ac. + 6 ac. growth for 1 wk.

$\therefore$ 1 " 8 " $\frac{1}{7}$ ac. + $\frac{8}{7}$ "

And 1 " 1 " $\frac{1}{56}$ ac. + $\frac{1}{7}$. "

Again,

16 oxen in 9 wks. eat 6 ac. + 54 ac. growth 1 week.

$\therefore$ 1 " 9 " $\frac{3}{8}$ ac. + $\frac{27}{8}$ " "

And 1 " 1 " $\frac{1}{24}$ ac. + $\frac{3}{8}$. " "

$\therefore$ $\frac{1}{56}$ac. + $\frac{1}{7}$ac. growth = $\frac{1}{24}$ac. + $\frac{3}{8}$ac. growth; and hence 1ac. growth 1 week = $\frac{1}{88}$ac.

The question now is, If 14 oxen eat 2 ac. + 6 × $\frac{1}{39}$ ac. (= 2 $\frac{2}{13}$) in three weeks, how many oxen will eat 24 ac. + 24 × $\frac{6}{39}$ ac. (= 27 $\frac{9}{13}$ ac.) in 6 weeks?

$$
\begin{array}{llll}
 & 2\frac{2}{13} \text{ in } 3 \text{ weeks by } 14 \text{ oxen,} & & \\
\therefore 1 & \text{"} \ 1 & \text{"} & \dfrac{14 \times 3}{2\frac{2}{13}}. \\
\text{And } 27\frac{9}{13} & \text{"} \ 6 & \text{"} & \dfrac{14 \times 3}{2\frac{2}{13}} \times \dfrac{27\frac{9}{13}}{6} = 90 \text{ oxen.}
\end{array}
$$

7. At what time between 5 and 6 will the hour and minute hands of a clock be together?

The *hour* hand goes round *once* in 12 hours, and the minute hand *twelve* times; that is, the minute hand gains 11 rounds in 12 hours: this affords an easy solution for all such questions.

At 5 o'clock the hour hand is 5 hour spaces = $\frac{5}{12}$ of a round in advance; we have then:

$$
\begin{array}{llll}
11 \text{ rounds gained in } 12 \text{ hours,} & & & \\
\therefore 1 & \text{"} & \text{"} & \frac{12}{11} \ \text{"} \\
\text{And } \frac{5}{12} & \text{"} & \text{"} & \frac{12}{11} \times \frac{5}{12} = \frac{5}{11} \text{ hour} = 27\frac{3}{11} \text{ min.}
\end{array}
$$

past five.

8. At what time between 10 and 11 o'clock will the hands be directly opposite?

At 10 the min. hand is 2 hour spaces (= $\frac{1}{6}$ of a round in advance), it has ∴ 4 hour spaces = $\frac{1}{3}$ of round to gain.

It gains 11 rounds in 12 hours,

$$
\begin{array}{lll}
\therefore \ 1 & \text{"} & \frac{12}{11} \ \text{"} \\
\text{And } \frac{1}{3} & \text{"} & \frac{12}{11} \times \frac{1}{3} = \frac{4}{11} = 21\frac{9}{11} \text{ min. past ten.}
\end{array}
$$

9. The hour, minute, and second hands of a clock turn on the same centre, and are together at 12 o'clock; find when the second hand will be first midway between the other two.

The hour hand goes round once in 12 hours, the min. hand 12 times, and the second hand 720 times.

Take as the *unit* the space moved by ***hour* hand.**

Hour hand 1 space.

Minute " 12 " ∴ min. hand is 11 spaces in advance of hour hand.

Second hand 720 spaces, ∴ sec. hand is 708 spaces in advance of min. hand.

And since sec. hand bisects space between the other two, ∴ $708+\frac{11}{2}=713\frac{1}{2}$=*half a round*, ∴ 1427=*whole round*,

1427 spaces represent 12 hours.

And 1 " " $\frac{12}{1427}$ " $=30\frac{390}{1427}$ seconds.

10. With the force of the current only, a boat falls down stream a certain distance in 40 minutes, and is pulled back the same distance by a crew whose rate of rowing in still water is to that of the stream, as 11 to 7; how long does it take them?

Take distance for *unit*; then

$\frac{1}{40}$=rate of stream per minute, and

$\frac{11}{7}$ of $\frac{1}{40}=\frac{11}{280}$ " crew " still water.

In the upward pull the stream retards the crew to the extent of its own rate.

∴ $\frac{11}{280}-\frac{1}{40}=\frac{1}{70}$ per minute=rate against stream.

$\frac{1}{70}$ in 1 minute.

∴ 1 in 70 " time required.

11. A crew can row down stream a certain distance in 60 minutes, and up the same distance in 64 minutes; find the rate of the stream in terms of the distance.

Take the distance for *unit*; then

$\frac{1}{60}$ per minute=rate down, and

$\frac{1}{64}$ " = " up;

∴ $\frac{1}{60}-\frac{1}{64}=\frac{1}{960}$ =twice *rate* of *stream*, since it aids *down* rate and retards up rate. ∴ rate of stream per minute $=\frac{1}{960}\div 2=\frac{1}{1920}$ of the distance.

12. A crew can row down stream a certain distance

in 60′, and up stream the same distance in 70′; the rate of the stream being $\frac{1}{2}$ mile an hour, find the distance.

With the stream the crew makes $\frac{1}{2}$ mile an hour *more* than their rate in still water.

Against the stream the crew makes $\frac{1}{2}$ mile an hour *less* than their rate in still water.

∴ the difference between *down* rate and *up* rate is twice rate of the stream=1 mile. Then

In 1 hour at the *down* rate they make the whole distance.
In 1 hour at the *up* rate they make the distance−1 mile, which they do in 10′, *i. e.*,

In 10′ they do 1 mile against stream.
∴ " 1′ " $\frac{1}{10}$ "
and " 70′ " $\frac{1}{10}\times 70=7$ miles.

13. A merchant bought a quantity of Canadian tweed, and marked it at an advance of 25% on cost, and in selling it used a yard measure which was $\frac{3}{4}$ of an inch too short, his entire gain being $124.80; find the cost price of the cloth, and the amount gained by using the false measure.

25 per cent.$=\frac{1}{4}$ per unit; he gains $\frac{3}{4}$ inch on $35\frac{1}{4}$.
$=\frac{3}{4}\div 35\frac{1}{4}=\frac{1}{47}$, on which he has also a gain of 25%.
∴ $\frac{1}{47}+\frac{1}{4}$ of $\frac{1}{47}=\frac{5}{188}$ fraudulent gain.
∴ $\frac{1}{4}$ fair gain $+\frac{5}{188}$ fraudulent gain$=\frac{13}{47}$ total gain.
$\frac{13}{47}=124.80.$
∴ $\frac{1}{47}=\quad 9.60.$
and $1=\quad 9.60\times 47=451.20.$

14. A person has an estate which yields him a net income of £1620, after paying expenses to the extent of 10 per cent. He sells it, and invests the proceeds in the $4\frac{1}{2}$ per cents at 96, the income now being subject to charges of 5 per cent., and his net income is £16 17*s*.

6*d*. less than before. Find for how many years purchase on the gross income he sold the estate.

$1620-16\frac{7}{8}=1603\frac{1}{8}$=present income, after 5% reduction.

$\frac{95}{100}$ of gross income$=1603\frac{1}{8}$.

1 " $=1603\frac{1}{8}\times\frac{100}{95}=1687\frac{1}{2}$=income before reduction.

Also, $4\frac{1}{2}$ is received for 96,

∴ 1 " $96\div4\frac{1}{2}=\frac{64}{3}$,

And $1687\frac{1}{2}$ " $\frac{64}{3}\times1687\frac{1}{2}=36000$=amount received for estate.

Now find gross income from the estate.

$\frac{1}{10}$ of it goes in expenses, leaving 1620.

∴ $\frac{9}{10}=1620$,

$1=1620\times\frac{10}{9}=1800$ per annum.

∴ $36000\div1800=20$ years.

15. French standard silver has 90 % of pure silver, and English standard silver $92\frac{1}{2}$ % pure silver; 200 francs are coined from one kilogramme, which is equal to 15432 grains. Calculate the par of exchange between London and Paris, English standard silver being 5 shillings per ounce.

£1=20 shillings.

1*s*. $=\frac{1}{5}$ oz. stand. silver.

1 oz. stand. silver$=\frac{37}{40}$ pure (English).

1 oz. pure$=\frac{10}{9}$ stand. (French).

1 oz. stand. (French)=480 grains.

1 grain$=\frac{1}{15432}$ kilogrammes.

1 kilogramme=200 francs.

∴ £1$=\frac{20}{1}\times\frac{1}{5}\times\frac{37}{40}\times\frac{10}{9}\times\frac{480}{1}\times\frac{1}{15432}\times\frac{200}{1}=25{\cdot}57+$ francs.

16. A man began business with a certain capital; he gained 20 % the first year, which he added to his capital, and $37\frac{1}{2}$ % the second year, which he added to

his capital; the third year he lost 40 %; had he received \$600 more for the goods sold the last year, he would have cleared in the three years 2 % of his original capital: find the amount with which he commenced business.

$$20\ \% = \tfrac{1}{5} \text{ per unit,}$$
$$87\tfrac{1}{2}\ \% = \tfrac{3}{8} \quad \text{"}$$
$$40\ \% = \tfrac{2}{5} \quad \text{"}$$

Take original capital as unit; then

$1 + \frac{1}{5} = \frac{6}{5} =$ capital at end of 1st year; and

$\frac{6}{5} + \frac{3}{8}$ of $\frac{6}{5} = \frac{6}{5} + \frac{9}{20} = \frac{33}{20}$, capital at end of 2nd year; of this $\frac{2}{5}$ is lost the 3rd year, $\therefore \frac{33}{20} - \frac{2}{5}$ of $\frac{33}{20} = \frac{99}{100}$.

$\therefore \frac{1}{100}$ of capital was lost; but \$600 would have covered this loss and 2% $(= \frac{1}{50})$ besides, *i. e.*,

$$\tfrac{1}{100} + \tfrac{1}{50} = \tfrac{3}{100} = \$600.$$
$$\therefore \tfrac{1}{100} = 200.$$
$$\text{and} \quad 1 = 200 \times 100 = \$20{,}000.$$

17. English standard gold is $\frac{11}{12}$ fine, and $44\frac{1}{2}$ guineas weigh 1 lb. Troy; the weight of a shilling is $87\frac{3}{11}$ grains Troy, and pure silver is $14\frac{1393}{4840}$ times heavier than an equal value of pure gold. If silver were to fall one per cent. in value, find what change would have to be made in the alloy in a shilling in order that 20 shillings might still equal £1, the alloy being supposed to be of the same specific gravity as silver, and the weight of the shilling to remain unchanged.

$44\frac{1}{2}$ guineas $= £46\frac{29}{40}$.

$£46\frac{29}{40} = 1$ lb. Troy $= 5760$ grs. alloyed gold.

$= \frac{11}{12}$ of $5760 = 5280$ grs. pure gold.

$$\therefore £1 = \frac{5280}{46\frac{29}{40}} \text{ pure gold.}$$

$$\text{and } £\tfrac{1}{20} = 1s. = \frac{5280}{46\frac{29}{40}} \times 14\tfrac{1393}{4840} \times \tfrac{1}{20} \text{ grs. pure silver.}$$

$=80\frac{8}{11}$.

But 1*s*.$=87\frac{3}{11}$ alloyed silver,

∴ 1*s*. has $6\frac{6}{11}$ alloy and $80\frac{8}{11}$ pure silver, *i. e.*, in 40 parts there are 37 silver and 3 alloy. But silver falls 1 per cent. in value,

∴ 99 parts$=100$.

1 " $=\frac{100}{99}$.

and 37 " $=\frac{100}{99}\times 37=37\frac{37}{99}$, which would have to be substituted for the previous 37 parts.

∴ there would be $40-37\frac{37}{99}=2\frac{62}{99}$ parts of alloy in 40.

18. If the increase in the number of male and female criminals be 1.8 per cent., while the decrease in the number of males alone is 4.6 per cent., and the increase in the number of females is 9.8; compare the antecedent numbers of male and female prisoners.

$1{\cdot}8\ \% = \frac{9}{500}$ per unit,

$4{\cdot}6\ \% = \frac{23}{500}$ "

$9{\cdot}8\ \% = \frac{49}{500}$ "

The net *increase* is $\frac{9}{500}$ males$+\frac{9}{500}$ females.

The *decrease* of males is $\frac{23}{500}$.

The increase of females is $\frac{49}{500}$, which must cover the decrease of males ($=\frac{23}{500}$), and make up the net increase.

∴ $\frac{49}{500}$ females $=\frac{9}{500}$ females$+\frac{9}{500}$ males$+\frac{23}{500}$ males.

Or $\frac{40}{500}$ " $=\frac{32}{500}$ males; ∴ the numbers are as 5 to 4.

19. If I am allowed $1\frac{1}{4}$ per cent reduction on an amount charged to me for goods, and give my acceptance at 5 months for the net sum; and if by selling the goods forthwith for a bill of £162 12*s*. 2*d*., payable in 7 months, my present gain is $11\frac{1}{9}$ per cent.; find the amount originally charged to me, money being worth 5 % per annum.

$1\frac{1}{4}\%=\frac{1}{80}$ per unit, $11\frac{1}{9}\%=\frac{1}{9}$ per unit.

$\frac{1}{80}$ off leaves $\frac{79}{80}$ to be paid in 5 months; find present worth of this.

Int. on 100 for 5 mos. at 5% $=2\frac{1}{12}$, then

$$102\tfrac{1}{12} \text{ is worth } 100,\ \ 1 \text{ is worth } \frac{100}{102\frac{1}{12}}=\tfrac{48}{49}.$$

$$\therefore \quad \text{P. W. of } \tfrac{79}{80}=\tfrac{79}{80}\times\tfrac{48}{49}.$$

Now find present worth of £162 12*s*. 2*d*. $=$ £$162\frac{73}{120}$, for 7 months at 5 %.

Int. on 100 for the time and rate $=2\frac{11}{12}$, then

$$102\tfrac{11}{12} \text{ is worth } 100,\ 1 \text{ is worth } \frac{100}{102\frac{11}{12}}=\tfrac{240}{247}.$$

$\therefore$ P. W. of $162\frac{73}{120}=\frac{19513}{120}\times\frac{240}{247}$: but this is $\frac{1}{9}$ more than the former P. W., *i.e.*,

$\frac{79}{80}\times\frac{48}{49}$ of original charge $=$ £$\frac{9}{10}\times\frac{19513}{120}\times\frac{240}{247}$, and

$$\therefore \quad 1=£\tfrac{9}{10}\times\tfrac{19513}{120}\times\tfrac{240}{247}\times\tfrac{80}{79}\times\tfrac{49}{48}=£147.$$

20. A man bought a farm for \$4500, and agreed to pay principal and interest in 4 equal annual payments; how much was the annual payment, money being worth 6 per cent.?

The amount of \$4500 for 4 yrs. at 6% $=5681{\cdot}14632$ (comp. int.)

Then $a\ \{1+1{\cdot}06+(1{\cdot}06)^2+(1{\cdot}06)^3\}=5681{\cdot}14632$ (where a = annual payment), or $a\times 4{\cdot}374616$.

$$\therefore \quad a=1298{\cdot}66+.$$

21. Purchased goods of Adam Miller & Co., Toronto, as follows:

1876, Feb.	2.	Fancy goods	on 8	months'	credit,	\$460.
"	5.	Stationery	" 4	"	"	680.
" Mar.	28.	Books	" 5	"	"	560.
" Apr.	12.	Books	" 5	"	"	840.

Find the equated time for the payment of all these bills.

The 1st is due May 2nd.
" 2nd " June 5, or 34 days from May 2nd.
" 3rd " Aug. 28, or 118 days from May 2nd.
" 4th " Sept. 12, or 133 days from May 2nd.

$680 for 34 days = $1 for 23120 days.
$560 " 118 " = $1 " 66080 "
$840 " 133 " = $1 " 111120 "

∴ the entire credit = credit on $1 for 200920 days, = credit on $2540 (= sum of bills) for $\frac{1}{2540}$ of 200920 days = $79\frac{13}{127}$ days.

22. Bought goods of Thwaite, Eby & Co., Toronto, as follows:

1876, April 10. Teas on 2 months' credit, $300.
May 20. " 200.
June 15. " 800.

On this account payments were made as follows:

1876, April 20. Cash, $410.
" June 10. Cash, 120.
" July 20. Cash, 360.

Find when the balance of the ac. is due.

Take the last date as the date of reckoning. Then the Dr. side gives

300 for 40 days = $1 for 12000 days.
200 for 61 " = $1 for 12200 "
800 for 35 " = $1 for 28000 "
1300 52200

Cr. side gives

$410 for 86 days = 35260 for $1.
$120 for 40 " = 4800 "
$360 for 0 " = 0 "
$890 40060

$$\begin{array}{r@{\qquad\qquad}r} 1300 & 52200 \\ 890 & 40060 \\ \hline 410 & 12140 \end{array}$$

Hence I owe \$410, and the interest on \$1 for 12140 days, which interest = that on \$410 for $\frac{1}{400}$ of 12140 days = 30 days very nearly; ∴ the balance is due 30 days before July 20, *i. e.* on June 20.

The method of the two preceding questions is not mathematically correct, as it assumes that *interest* is equivalent to discount; it is, however, the method usually employed in actual business transactions.

23. The true discount on a sum of money for one year at 5 per cent. is \$1 greater than the sum of the true discounts of one half of it at 4 per cent. and the other half at 6 per cent. Find the amount.

Take the amount as *unit*.

105 gives 5 discount, 104 gives 4 ∴ 1 gives $\frac{1}{26}$.
1 " $\frac{5}{105}=\frac{1}{21}$ 106 " 6 ∴ 1 " $\frac{3}{53}$.

We have ∴

Discount on $1=\frac{1}{21}$ (5%).
" on $\frac{1}{2}=\frac{1}{2}\times\frac{1}{26}=\frac{1}{52}$ (4%).
" on $\frac{1}{2}=\frac{1}{2}\times\frac{3}{53}=\frac{3}{106}$ (6%).

And the sum of the last two is less than the first by \$1, *i.e.*,

$\frac{1}{21}-(\frac{1}{52}+\frac{3}{106})=\$1.$
Or $\frac{5}{57876}=\$1.$
∴ $1=\$11,575.20$, the required amount.

24. I sold an amount of railway stock at 104, and invested the proceeds in the 3 per cents at 91; I afterwards sold out the three per cents at 95, and, repurchasing the railway stock at 105, found myself a gainer of £50 stock by the whole transaction. Find the amount of railway stock owned at first.

Take this stock as *unit*. Railway stock sold at 104.

100 brings 104, 1 brings $\frac{104}{100}=\frac{26}{25}$.

In the 3 % 91 bought 100.

$\therefore$ 1 " $\frac{100}{91}$, and $\frac{26}{25}$ bought $\frac{26}{25}\times\frac{100}{91}$; this was sold at 95.

100 sold for 95,

1 " $\frac{95}{100}=\frac{19}{20}$,

And $\frac{26}{25}\times\frac{100}{91}$ " $\frac{19}{20}\times\frac{26}{25}\times\frac{100}{91}$; this was reinvested in railway bonds at 105 for 100, or $\frac{20}{21}$ for 1.

$\therefore$ $\frac{19}{20}\times\frac{26}{25}\times\frac{100}{91}\times\frac{20}{21}=\frac{152}{147}$=amount of repurchased stock, and $\therefore$ $\frac{152}{147}-1=\frac{5}{147}$=gain=£50 stock.

$\therefore$ $\frac{1}{147}$ =£10 stock,

And £1470 stock.

CHAPTER II.

FUNDAMENTAL RULES, VULGAR AND DECIMAL FRACTIONS, &c.

SIMPLE RULES.

I.

1. Explain why in the addition of numbers the operation is begun at the unit's place. Is this necessary?

2. What is the difference between the aggregate of 1050, 325, 1769, 150801, and a million? Show that the same difference is obtained by taking one of the numbers from a million, another from the remainder, and so on for the rest of the numbers.

3. How may the accuracy of the process of subtraction be verified? Give an example.

Substract 819 from 918, explaining the process.

4. A merchant exchanges a stock of goods worth $6725, and a house worth $3120, with a farmer for a farm valued at $5900,—the farmer paying the balance in money. What sum must the merchant receive?

5. Upon what principle is the ordinary method of multiplication based? Is there any advantage in beginning with the right-hand figure (1) of the multiplicand, (2) of the multiplier?

6. Exemplify the truth that two or more factors will give the same product in whatever order they are multiplied

7. A speculator bought 150 head of cattle, and 47 mules. He made a profit of $18 a head on the former,

and $17 each on the latter; what was gained by the speculation ?

8. What is the object of division ? In what cases may it be considered as a shortened form of subtraction?

9. If the quotient be 5000 when the divisor is 2001 and the remainder 100, what is the dividend ?

10. Divide 10149 by 7 and the quotient by 5 ; thence deduce the true remainder, and show that it is the same as after the division of 10149 by 35.

II.

1. What number is that to which if 38 and 5 times 38 be added, and the sum so found be increased by 7 times itself, the total sum is 2400 ?

2. A lends B $9780 ; B repays A by giving him bank stock to the amount of $1946, a farm worth 4 times as much as the bank stock *minus* $999, and the balance in cash ; how much cash did B pay A ?

3. How much time, in the course of 33 years, will a person who rises at 5 o'clock a. m., gain over another who rises at 8 o'clock, supposing both to go to bed at 10 p. m., and the year to be 365¼ days ?

4. If the quotient of a divison question be $\frac{1}{19}$ of the divisor, and the divisor be 83 times greater than the remainder, find the dividend when the remainder is 212.

5. In 1876 a call of £22 per share was made on the convertible five per cent. stock issued at £90, and the sum realized was £94754 ; find the number of shares issued.

6. Find the circumference of a wheel which revolves 1460 times in a mile.

7. When A dies at the age of 67, B is 31 years old ;

B dies at the age of 59, when C is 25; at C's death, when he is 70, D is 43 and dies 26 years after C; find the interval between A's birth and D's death.

8. A dealer in horses gave $9900 for a certain number, and sold a part of them for $3825 at $85 each, and by so doing lost $5 a head; for how much per head must he sell the remainder so as to gain $1140 on the whole?

9. A receives on 225 shares of mining stock an annual dividend of $96 a share; and B receives the same total annual dividend on 270 shares of oil stock; find the annual dividend on one share of B's stock.

10. A drover bought a number of cattle for $17100 and sold a certain number of them for $12474, at $126 a head, gaining on those he sold $2574; how many did he buy at first, and how much did he gain on each sold?

III.

1. How may the accuracy of the process of subtraction be verified? Give an example.

Show that the difference of 254 and 125 is the same as the difference when these numbers are each increased by 123.

2. In the multiplication of numbers, how do you prove the correctness of the operation by casting out the nines? Explain and give reasons for the rule, and show the errors to which it is liable.

3. The product of two numbers is 760,069,388, one of them being 26078; show that their sum divided by 1534 is 36.

4. If division by a composite number be performed by successively dividing by its prime or composite factors, show how the complete remainder may be found.

Ex., 1437281 divided by 105.

5. Find that number which, when divided by 90009 gives 746115 for a quotient, with 83337 for a remainder?

6. If 7 yards of cloth cost $84, how many pounds of butter at 40 cents a pound must I pay for 4 yards of the same cloth?

7. A ship sailed 56 hours at the rate of 11 miles per hour, when she encountered a storm of 16 hours' duration, which drove her back at the rate of 14 miles per hour. How far from port was she at the expiration of the 72 hours?

8. A is worth 1265 dollars, B is worth 4 times as much as A, and 183 dollars, and C is worth three times as much as A and B lacking 2343 dollars. How much are B and C worth respectively? and how much are they all worth?

9. Explain how any number may be multiplied by 11 by addition, and divided by 9 by subtraction. Ex., 45789 × 11 and 45789 ÷ 9.

10. What number divided by 528 will give , for quotient and leave 44 as a remainder?

COMPOUND RULES.

IV.

1. The weekly amount of wages at a factory where an equal number of men, women, and boys was employed was £82 16*s.*; the men received 4*s.* 6*d.* per day, the women 2*s.*, and the boys 1*s.* 2*d.*: how many were there of each?

2. The fore-wheel of a carriage is 8 ft. in circumference, and in a distance of 18 miles makes 2340 revolu-

tions more than the hind wheel; find the circumference of the hind-wheel.

3. The length of a wall, according to the French metric system, is 9 metres 4 decimetres 8 centimetres; find its length in English yards, the length of the metre being 39.371 inches.

4. A rod of brickwork, viz., a square pole or 272¼ square feet, has a standard thickness of a brick and a half: if a piece of work be 48 feet long, 22 feet high and 3½ bricks thick, to how many rods of standard thickness is it equivalent?

5 Divide $2640.75 among 4 men, 6 women, and 8 children, giving to each child double a woman's share, and each woman triple a man's share.

6. Express 3547962 sq. feet in acres, roods, and poles.

7. Multiply the difference between 25 lbs. 2 oz. 8 dwts. 18 grs., and 27 lbs. 5 oz. by 191½.

8. If 44½ guineas weigh a lb. Troy when 32 halfpennies weigh a lb. Avoirdupois, what is the difference in grains between the weights of a guinea and a halfpenny, a lb. Avoirdupois containing 7000 grains?

9. A person pays $62 50 income tax, which is at the rate of $2\frac{1}{12}$ cents on the dollar; find his gross income.

10. Divide 448 ac. 3 rds. 24 p. of land among A, B, C, and D, so that A shall have ⅓ of the whole + 4 ac. 3 rds. 6 p.; B ⅕ of the whole; C ⅓ of what remains; and D. the rest.

V.

1. In a multiplying train of wheels a driver of three inches radius acts on a ½-inch pinion keyed to a 8-inch

wheel; the second wheel will therefore move 6 times as fast as the first. Supposing there to be 5 such wheels and pinions following a driver which makes 40 revolutions a minute, find how many revolutions the last will make in an hour.

2. On a certain parallel the earth measures 12,315 miles round. Find the length of a minute of longitude on that parallel.

3. A grain merchant bought 40640 lbs. of wheat at $1.20 a bushel, and shipped it to Toronto at an expense of three cents a bushel. Before he sold it there was a loss in handling, etc., of $\frac{1}{80}$ of the original weight; his profit on the transaction was $69.85. At what price did he sell the wheat?

4. Find the difference in the price of a field of 23 acres at £53 17*s*. 4½*d*. per acre, and at 6*s*. 8¾*d*. per pole.

5. Show that the process by which Long Division is performed is the converse of that by which Long Multiplication is performed.

6. The returns of a gold mine are 241 tons of ore, yielding 2 oz. 1 dwt. 15 grs. of fine gold per ton, and 193 tons yielding 1 oz. 12 dwts. 9 grs. per ton. Find the value in dollars and cents of the whole yield; at £3 17*s*. 10½*d*. per oz., reckoning the £1 at $4.80.

7. Explain the rsason for what is called "carrying one" in subtraction. Show by an example that there is no difference in principle between "Simple" and "Compound" Subtraction.

8. A sidereal day is 23 h. 56 m. 4 sec. mean solar time. How many sidereal days are there in the sidereal year of 365¼ solar days?

9. The profits of a tradesman are $135.16 per week. Of this sum he pays 5 persons at the rate of $5.04 each,

8 others at the rate of $4.20 each; his expenses for rent, etc., are $1785.64 per year. Find his net annual income.

10. How many guineas, sovereigns, half crowns, shillings and sixpences (and of each an equal number), are there in £609 15*s*.

VI.

1. A rod 540 inches long, has a piece of 8 inches cut off from it, then another piece of the same length cut off the remainder, then another piece of same length, then another, and so on: how often may this be done, and what is the length of the piece remaining at last?

2. The sum of $142,362 was paid for a quantity of land at $99 an acre: find the number of acres.

3. If it be supposed that as many persons die in 33 years as are equal to the entire population, it is required to find how many persons, on an average, die annually out of every million.

4. Ten bricklayers and 5 carpenters were employed in building a house, each of the former receiving $12·96 a week, and each of the latter $13·92 a week; what was the amount of wages in 16 weeks?

5. A silversmith purchases a large dish weighing 8 oz., and forms it into 2 dozen dessert spoons, and one dozen table spoons; if the latter together weigh 28 oz., find the weight of each dessert spoon, and its value at [illegible] of a cent per grain.

6. An estate worth £2178 14*s*. 10*d*. is divided among three children; the first has £927 14*s*. 9*d*., the second has half as much, and the third has the remainder. How much did the third receive?

7. How many times may £24 11*s.* 6¾d., be subtracted from £8067, and what will the remainder be?

8. Compound a mixture, 3 parts of which shall each contain 4 oz. 3 drs. 8 grs. of one ingredient, 4 parts shall each contain 5 drs. 2 sc. 7 grs. of another ingredient, and 5 parts shall each contain 7 drs. 2 sc. of a third ingredient, and determine the weight of each one-twelfth part of the mixture.

9. A person bought 374 eggs at 2 for a penny, and a second quantity at 3 for twopence; he paid altogether £1 9*s.* 11*d*; how many eggs did he buy at 3 for twopence?

10. A person employs 50 men and 35 boys, who work reepectively 12 hours and 8 hours a day during 5 days of the week, and half time the other day; each man receives 24 cts. and each boy 4 cts. an hour. What is the amount of wages for the year?

MEASURES AND MULTIPLES.

VII.

1. What is meant by saying that one number is *a common measure* of two or more numbers? Also, *the greatest common measure?*

2. A gentleman has a piece of ground, the sides of which measure 225 ft., 297 ft., and 369 ft. He wishes to enclose it with a fence having panels of uniform length. What is the longest panel that can be used for that purpose?

3. When is a number *a common multiple* of two or more numbers, and when *the least common multiple?*

How many acres of land would admit of being divided into a number of farms containing 150, 200, or 250 acres each?

4. Show by examples whether the greatest common measure of two numbers can ever exceed the difference of the numbers; and whether their least common multiple can ever exceed their product.

5. A shepherd on telling his sheep found that when he told them out by twos, threes, fours, and fives, he had none left, and he knew his flock was above 300 but less than 400. What number had he?

6. Explain what is meant by one number being prime to another. When two numbers are prime to each other, are they necessarily prime
Give examples.

7. Resolve 132288, 107328, 138216, and 97344, into their prime factors. And find their greatest common measure and least common multiple.

8. The product of four consecutive numbers is 1680; find them.

9. A, B, C, and D start together, and travel the same way around an island which is 600 miles in circuit. A goes 20 miles per day, B 30, C 25, and D 40. How long must their journeying continue, in order that they may all come together again?

10. A certain school consists of 132 junior, and 99 senior students. How might each of the two classes be divided so that the whole school should be distributed into equal sections?

VIII.

1. When a series of numbers have been resolved into their prime factors, which of these factors must be taken to form by their product (1) the greatest common measure, (2) the least common multiple of the numbers? Form the greatest common measure and the

least common multiple of 405, 570, 910.

2. Find the least number of ounces of standard gold which can be coined into an exact number of half-sovereigns, if gold be worth 3*l.* 17*s.* 10½*d.* per ounce.

3. What is the greatest number of ounces Avoirdupois that will exactly measure 15 cwts. 1 qr. 27 lbs. 10 oz., and 21 cwts. 2 qrs. 21 lbs. 14 oz. (28 lbs. = 1 qr.)

4. Prove that every common measure of dividend and divisor is a measure of the remainder.

5. If the step of a man be 36 inches, of a woman 24, and of a boy 18, how many times will all three step together in walking 5 miles, supposing all three start together?

6. Four bells toll at intervals of 3, 7, 12, 14 seconds, respectively, and begin to toll at the same instant, when will they next toll together?

7. Four points, moving each at a uniform speed, take 198, 495, 891, 1155 seconds respectively to describe the length of a given straight line. Supposing them to be together at any instant at the same end of the line, and to move in it from end to end continually, what interval of time will elapse before they are together at the same point again?

8. A teacher having a school of 144 boys and 128 girls divided into the largest possible equal classes, so that each class of girls should number the same as each class of boys. What was the number of classes?

9. There is a street 354 rods long, and the land on one side of this street is owned by three persons, A, B, and C. A has 102 rods fronting the street, B 114 rods, and C 138 rods. They agree to divide their land into village lots in such a manner that the lots shall be of

the greatest width that will allow each person to form an exact number of lots out of his land. What is this width ?

10. If three bodies move uniformly in similar orbits round the same centre in 87, 224, 365 days respectively: supposing all three in conjunction at a given time, find after how many days they will be in conjunction again.

IX.

1. Define Factor, Common Factor, and Highest Common Factor. State and illustrate the principle on which the process for finding the H. C. F. depends.

2. Find the Highest Common Factor of 15561, 11115, 13585.

3. Suppose that three men in 810, 840, 900 days respectively, do a certain piece of work, express the relative values of the work of the three men in the simplest manner possible.

4. A farmer has 240 bushels of wheat and 920 bushels of oats, which he desires to put into the least number of boxes of the same capacity, without mixing the two kinds of grain. Find how many bushels each box must hold.

5. How many rails will enclose a field 14599 feet long by 10361 feet wide, provided the fence is straight and 9 rails high and the longest that can be used ?

6. Define Multiple, Common Multiple, Least Common Multiple. Show that the L. C. M. of two numbers is their product divided by their H. C. F.

7. Find the L. C. M. of 68590142 and 85044059.

8. A can walk 3 miles in 48 minutes, B 3 miles in 72 minutes, C 3 miles in 96 minutes, and D 3 miles in 108 minutes. How far can each go so that on their re-

turn they may arrive together at the place from which they started ?

9. If in two days A can build 28 rods of fencing, B 50 rods, C 16 rods, and D 40 rods, find the least number of rods that will furnish an exact number of days' work.

10. An island is 48 miles in circumference. A, B and C have to walk round it till they all arrive together at the starting point. A walks 2, B 3, and C 4 miles an hour. How many times must each go round before the task is accomplished ?

FRACTIONS.

X.

1. What are the advantages in arithmetical operations of employing fractions expressed by the smallest number possible ? State how fractions expressed by large numbers may be reduced to equivalent fractions expressed by smaller numbers. Is this always possible ?

2. Explain why fractions having different denominators must be altered in form before their sum or difference can be expressed by one fraction.

3. Add together the greatest and least of the fractions $\frac{3}{4}$, $\frac{7}{8}$, $\frac{11}{12}$, $\frac{19}{20}$, and subtract this sum from the sum of the other two fractions.

4. Change the fractions $\frac{37}{46}$, $\frac{78}{97}$, and $\frac{115}{143}$, into fractions having a common denominator; and express the difference of the first two as a fraction of the difference of the second two.

5. What fraction subtracted from the sum of $\frac{3}{4}$ and $\frac{5}{6}$ will have unity for the remainder ?

6. What fraction divided by $\frac{2}{3}$ of $\frac{4}{5}$ of $1\frac{1}{4}$ will give the quotient unity?

7. Prove the rule for dividing a fraction by an integer, and simplify the following expression:

$$\frac{4\frac{11}{13} \text{ of } \frac{8}{95} \text{ of } 7\frac{3}{7}}{12\frac{1}{55}-2\frac{3}{7}}+\frac{2\frac{1}{3}+1\frac{35}{48}}{9\frac{2}{7}-3\frac{39}{112}},$$

8. Reduce $\dfrac{8\frac{1}{2}-2\frac{1}{6}}{\frac{1}{4} \text{ of } (\frac{1}{5}+\frac{1}{7})} \div 15\frac{5}{9}$ to its simplest form.

9. From the rule for the multiplication of vulgar fractions deduce the rule for division.

Multiply the sum of $\frac{1}{3}$, $\frac{1}{5}$, and $\frac{3}{4}$, by the difference between $\frac{4}{5}$ and $\frac{2}{3}$.

Reduce to its simplest form $2\frac{1}{2}+\dfrac{1}{3\frac{1}{3}+\dfrac{1}{4\frac{1}{4}}}$.

10. Reduce $\dfrac{2\frac{1}{2}-\frac{5}{6}}{2\frac{1}{3}+\frac{5}{6}}+\dfrac{7}{12}$ of $\dfrac{9\times10}{14\times8}-\dfrac{22\frac{1}{2}}{80}$ to its simplest form.

XI.

1. What is meant by reducing one concrete number to the fraction of another? Give examples.

2. Explain the method of adding and subtracting concrete fractional numbers:

Add £$1\frac{7}{9}$, $9\frac{1}{3}$*s.*, $6\frac{3}{4}$*d.*, expressing the sum in the fraction of £100.

3. Reduce 1 lb. Troy to the fraction of 1 lb. Avoirdupois.

How many minutes are there in $\frac{5}{73}$ of a year + $\frac{1}{56}$ of a week + $\frac{5}{12}$ of an hour?

4. Reduce to its simplest form, *i.e.*, to days, hours, &c., the following expression:

$$1\frac{1}{3} \text{ of } \frac{4\frac{1}{2}}{5\frac{1}{4}} \text{ of } \frac{18s.\ 6\frac{1}{4}d.}{£1} \text{ of 3 days 2 hours.}$$

5. What fraction of 2 cwt. 14 lbs. is $\frac{1}{4}$ of 2 qrs. 14 lbs. ?

6. How much ironstone ore must be raised from a mine, so that on losing $\frac{17}{40}$ in roasting, and $\frac{8}{19}$ of the remainder in smelting, there may result 506 tons of pure metal ?

7. Find a sum of money which shall be the same part of £61 9*s.* 1*d.*, that 2 cwt. 2 qrs. 10 lb. is of 36 cwt. 1 qr.

8. If a mixed metal be composed of 11 parts of tin to 100 parts of copper, how much copper and how much tin will be required to make 24 cwt. of this metal ?

9. On measuring a distance of 32 yds. with a rod of a certain length, it was found that the rod was contained 41 times with half an inch over. What is the distance approaching nearest to 77 yds. which can be measured exactly by the same rod ?

10. If a yard measure be incorrect by one-eighth of an inch, find the error in measuring a distance of 500 yds. 2 ft. 6 in. Explain, if there is any difference, whether the error be in excess or defect.

XII.

1. Simplify

$$\frac{15}{4} \text{ of } \frac{\frac{1}{2} \text{ of } \frac{5}{9} \times 7\frac{1}{2}}{\frac{1}{3} + 4\frac{1}{2} \text{ of } \frac{4}{27}} + \frac{7\frac{1}{2}}{8\frac{3}{4}} \text{ of } \frac{\frac{4}{5} - 2\frac{1}{3} + 1\frac{9}{15}}{\frac{7}{95} + 150\frac{5}{19} - \frac{1302}{15}}.$$

2. Find the quotient when $8\frac{3}{4}$ of $\dfrac{8\frac{5}{7} \div 2\frac{4}{11}}{\frac{5}{7} \text{ of } (11\frac{3}{8} - 2\frac{1}{8})}$ is divided by $7\frac{1}{2}$ of $\dfrac{8\frac{2}{3} \text{ of } 5\frac{2}{5}}{5\frac{1}{15} + \frac{1}{4} \text{ of } 4\frac{2}{3}}$.

3. Reduce 7 weeks, 3 days, 11 hours, 52 minutes, 40 seconds, to the fraction of $365\frac{1}{4}$ days.

4. How many yards of paper $\frac{3}{8}$ yd. wide, will be required for the walls of a room which is $20\frac{3}{8}$ ft. long, $11\frac{1}{8}$ ft. wide, and $12\frac{1}{2}$ ft. high? How much will it cost at $4\frac{1}{2}$ cents a yard?

5. A man lost one quarter of his property in speculation; he afterwards purchased a partnership in business for $16000, and had still $6000 left. What was he worth at first?

6. Simplify $\frac{1\frac{2}{5}}{3\frac{1}{2}} - \frac{5\frac{5}{8}}{6\frac{1}{4}}$ of $\left(\frac{1}{5} - \frac{\frac{1}{2}-\frac{1}{3}}{4\frac{3}{4}-3\frac{2}{9}}\right)$, and $\frac{1}{3\frac{1}{5}} - \frac{2\frac{1}{4}}{9} + \frac{3\frac{3}{8}}{12} + \frac{\frac{4}{7}}{4\frac{5}{7}} + \frac{3-2\frac{1}{3}}{4-3\frac{1}{4}}$.

7. The owner of a ship which was valued at $10,000 sells $\frac{2}{5}$ of his share for $3,800, and then $\frac{1}{3}$ of the remainder for $1,800; what did he gain or lose by the transaction?

8. Find the value of

$$\frac{23}{2\frac{2}{3}+\frac{2}{5}} \times \frac{4\frac{4}{15} \text{ of } 2\frac{5}{8}}{5\frac{1}{5}-4\frac{1}{2}} \text{ of } 5s. \;-\; \frac{\frac{120}{119}-\frac{1}{239}}{1+\frac{1}{239} \text{ of } \frac{120}{119}} \text{ of £2. } 10s.$$

9. A contract is to be finished in 154 days, and 50 men are set to work at once; at the end of two-sevenths of the time it is found that only one-fifth of the work is done; find what extra number of hands will be required to complete the contract, the last men employed working 12 hours per day, while the first lot worked throughout 10 hours per day.

10. Suppose that $\frac{2}{35}$ is represented by unity, what number will represent $\frac{4}{35}$?

FRACTIONS.

XIII.

1. Define a fraction. Explain the functions of the numerator and denominator. Shew that $\frac{4}{5}$ of $\frac{6}{7} = \frac{24}{35}$. (Hamblin Smith, Art. 65.)

$$\text{Reduce } \frac{20}{21} - \left(\frac{48\frac{1}{2} + 7\frac{2}{3} - 16\frac{1}{4}}{16\frac{1}{2} \times 14\frac{1}{3} \times 12\frac{1}{4}} \div \frac{5\frac{2}{7}}{7\frac{2}{5}}\right)$$

3. A, B, and C are joint owners of a ship; C's share is valued at \$2000, A's share is $\frac{1}{3}$ of B's, and the sum of their shares is $\frac{3}{4}$ of the value of the whole ship. If A buys B's share, what will be the value of the part of the ship he then owns?

4. Reduce 14 wks. 6 days 23 hrs. 45 min. 20 secs., to the fraction of a year of $365\frac{1}{4}$ days.

5. Five brothers join in paying a sum of money; the eldest pays $\frac{2}{7}$ of it, and the others pay the remainder in equal shares; it is found that the eldest brother pays \$$300\frac{9}{176}$ more than a younger brother's share. Find the sum of money.

6. A can do a piece of work in a day of 10 hours, B can do it in $\frac{4}{5}$ of a day, and C in $\frac{9}{10}$ of a day; A works by himself 2 hours, is then joined by B, and they work together 3 hours more, when C joins them; how long will it now take the three to complete the work?

7. The dimensions of a room are 29 ft. 6 in. by 11 ft. 3 in.; what will be the expense of carpeting it with carpet $\frac{5}{8}$ yd. wide, and costing 90 cents a yard?

8. Reduce to lowest terms

$$\frac{217 \text{ miles } 5 \text{ f. } 18 \text{ p. } 2 \text{ yd. } 2 \text{ ft. } 1 \text{ in.}}{506 \text{ miles } 2 \text{ f. } 23 \text{ p. } 1 \text{ yd. } 2 \text{ ft. } 7 \text{ in.}}$$

9. In a regiment consisting of English, Irish and

Scotch, $\frac{3}{8}$ of the regiment were Irish, $\frac{3}{10}$ Scotch; but after 250 Irish and 200 Scotch were added to the regiment $\frac{9}{40}$ were English: find the original strength of the regiment and the number of English, Irish, and Scotch, respectively.

10. Find the difference in dollars and cents between $\frac{3}{8}$ of $1\frac{7}{9}$ of 16 times £8 17*s*. 6*d*. and $(\frac{4}{5}-\frac{1}{7}+2\frac{1}{8})$ of $(\frac{41}{42}\times 1\frac{2}{5}\div\frac{41}{225})$ of \$480, the £ being \$4.80.

XIV.

1. Define a decimal fraction, and taking ·4568 as an example, show from your definition that $\cdot 4568=\frac{4568}{10000}$.

2. What are the advantages of decimal fractions over ordinary fractions? State why decimal fractions are not always used in calculations.

3. State and explain the rule for reducing a vulgar fraction to a decimal.

Find the values of $\frac{1}{4}\div\cdot 01001$ and of $10\cdot 01\div\frac{1}{50}$.

4. State and explain the rule for the multiplication of decimals.

Multiply the sum of 2·616, ·00132, and 1·0448, by ·62639.

5. State and prove the rule for the division of one decimal by another, and apply it to the two following examples:—

$$10\cdot 836\div 5\cdot 16;\quad 1083\cdot 6\div 5\cdot 16,$$

and prove the truth of the result by vulgar fractions.

6. In what cases can an ordinary fraction be expressed by a *finite* decimal? Show that the number of decimal places in such cases may be inferred from the factors of the denominator.

7. Perform the following operations in decimals:—

$$(7\tfrac{1}{2}\text{ of }\tfrac{1}{5}+\tfrac{17}{25}-\cdot 02)\div\cdot 005.$$

Likewise find the value of $\frac{3}{4}$ of ·03, determining the recurring period.

8. Show that the product of two circulating decimals may produce a terminating decimal. Exemplify in the product of $\cdot 2\dot{1}4285\dot{7}$ by $\cdot 4\dot{6}$.

9. In what sense can a finite fraction be said to be equal to an indefinite repeating decimal? How must the sign = be understood in the expression $\frac{35}{99}=353535$ . . . . *ad infinitum*, in order that the expression may be satisfactory?

10. How many repeating and how many non-repeating figures will there be in the decimal equivalent to the fraction $\frac{98}{38673}$?

XV.

1. Reduce $.5\dot{4}$ of 7 oz. 15 drs. to the decimal of $4\frac{1}{12}$ lbs.; and $2\frac{1}{4}$ furlongs to the decimal of $7\frac{3}{5}$ of .3125 of 2 leagues.

2. Subtract $\dfrac{8\frac{4}{5}+\frac{29}{45}}{8\frac{3}{4}+14\frac{1}{36}}$ from $\dfrac{7\frac{1}{2}+1\frac{17}{22}}{8\frac{2}{3}+8\frac{23}{33}}$, and reduce to its simplest form $2+\cfrac{3}{1+\cfrac{3}{6+\cfrac{4}{5+\frac{1}{3}}}}$

3. A house and lot together cost $1600, and $\frac{3}{8}$ of the price of the lot was $\frac{5}{24}$ of the cost of the house; how much did each cost?

4. Simplify $\dfrac{2-\frac{1}{4}}{4}\times\dfrac{(8\frac{4}{7})^2}{12}+\frac{1}{2}\,\dfrac{(2+\frac{1}{5})}{3+\frac{1}{7}}+\dfrac{11\frac{3}{32}}{17\frac{1}{4}}$.

5. A merchant sold 20 bbls. of flour for $127½, which was $\frac{51}{80}$ of what he received for what he had left.

and which he sold at \$$6\frac{1}{4}$ a bbl.; how many bbls. in all did he sell ?

6. Divide $3\frac{3}{10}+1\frac{1}{9}$ of $\frac{3}{20}$ of $1\frac{1}{5}+2\frac{1}{7}$ of $4\frac{2}{3}$ by the difference between $\frac{2\frac{1}{2}-1\frac{3}{4}}{2\frac{1}{2}+1\frac{3}{4}}$ and $\frac{2\frac{1}{7}\times\frac{21}{45}}{2\frac{1}{3}\times\frac{6}{35}}$.

7. A man bought a horse for \$120, which was \$30 less than $\frac{5}{7}$ of one-and-a-half times what he sold him for. How much did he make on the sale of the horse ?

8. Simplify $\frac{3\frac{1}{2}\text{ of }1\frac{1}{4}}{1\frac{5}{6}\text{ of }3\frac{3}{4}}\div\frac{1\frac{3}{5}\text{ of }2\frac{1}{4}}{1\frac{1}{10}\text{ of }2\frac{1}{7}}$, and reduce to its lowest terms $\left(\frac{2\frac{1}{4}-\frac{2}{3}\text{ of }1\frac{5}{6}}{\frac{1}{5}\text{ of }3\frac{1}{3}+\frac{13}{36}}-\frac{1}{2\frac{1}{2}}\right)\div\frac{1}{2\frac{2}{3}}$.

9. Find the value of $.4\times(6\frac{2}{3}+2.5)$ of \$9.60 + $\frac{2{\cdot}25-\frac{2}{3}\text{ of }1\frac{5}{6}}{{\cdot}2\text{ of }3\frac{1}{3}+\frac{13}{36}}\times{\cdot}95$ of \$2.40 + $\frac{16{\cdot}8}{{\cdot}006}$ cents.

10. Find the quantity of coal consumed by a steamer for a voyage of 4043 miles, supposing her rate per hour to be 14·04 knots, and her consumption of coal 37 tons per day, a knot being $\frac{311}{270}$ of a mile.

XVI.

1. Show clearly how to change a vulgar fraction into a decimal ? Reduce $\frac{39}{40}$ to a decimal. What is the equivalent decimal fraction ? What is done with $\frac{39}{40}$ to bring it into this form ?

2. Reduce $\frac{12}{25}$ths of £20 to the decimal of £100.

3. By what decimal of one farthing does ·0009 of one shilling exceed ·00003 of one pound ?

4. Show that ·025 of £1 is double of ·05 of £1 5*s.*

5. Explain the reason why any number of shillings may be expressed in the decimal of a pound by multi-

plying the shillings by 5, and marking off two places of decimals.

6. Find the exact values of the following concrete decimals : ·379 of an ounce, and $\cdot 9\dot{5}\dot{4}$ of a pound Troy.

7. If the unit of Troy weight, called the pennyweight, contained 14.25 grains instead of 24, how many grains would make the pound Troy?

8. Express a pound Troy as the decimal of a pound Avoirdupois; and conversely, express a pound Avoirdupois as the decimal of a pound Troy.

9. Express in the fraction of a foot, the remainder after ·012 of a yard has been subtracted as often as it is possible from 1·087 yard.

10. What decimal of a day is 2 hours 12 minutes 10 seconds?

11. Divide 3 weeks 4 days 5 hours 6 minutes 7 seconds by 5 days 6 minutes 40 seconds, expressing the result as a decimal and stating its nature.

XVII.

1. Divide 27107·57 by ·003427, and reduce to a simple decimal $\dfrac{\frac{1}{3} \text{ of } 2\cdot179 - \frac{5}{6} \text{ of } \cdot8684}{\dfrac{2\frac{1}{3}}{5} - \dfrac{2}{5\frac{5}{8}} + \dfrac{1\frac{5}{6}}{4\frac{5}{7}}}$.

2. After spending \$10 less than $\frac{3}{5}$ of my money, I had \$15 more than $\frac{3}{10}$ of it left; how much had I at first?

3. If $\dfrac{5\frac{5}{8} \div \frac{2}{3}}{(1\frac{1}{5} \text{ of } \frac{5}{9}) \div 10\frac{1}{3}} \times \frac{2}{5} \text{ of } \dfrac{1\frac{1}{2} \text{ of } 4\frac{1}{9}}{13\frac{7}{8} \text{ of } 5\frac{1}{3}} \times \dfrac{5}{279}$ of my farm, be worth \$500, what is the whole farm worth?

4. A traveller having completed $\dfrac{4\frac{10}{11}}{8\frac{1}{9}}$ of $\dfrac{1\frac{2}{5}}{2\frac{7}{10}}$ of his

journey in $\frac{10\frac{3}{5}+10\frac{3}{5}}{5\frac{1}{3}-2\frac{2}{5}}$ hours, performed the rest, which was 88 miles, at the rate of $24\frac{3}{4}$ miles per hour: find the length of his journey, and the time he was travelling.

5. Obtain a recurring decimal equal to $12{\cdot}\dot{5}-6{\cdot}1\dot{2}\dot{7}-6{\cdot}2\dot{5}4\dot{1}+4{\cdot}7283\dot{6}-2{\cdot}53\dot{8}8606\dot{7}$.

6. Find the value of $\frac{\frac{1}{3}\text{ of }\frac{2}{3}+\frac{1}{4}\text{ of }\frac{5}{6}}{\frac{1}{3}+\frac{3}{7}-\frac{8}{9}+\frac{71}{63}}$ of $\frac{6\frac{5}{18}}{4\frac{5}{8}}$ of $\frac{1}{3}$ of $2\frac{1}{2}$ square feet.

7. A has $3 more than $\frac{1}{3}$ of the whole of a sum of money; B has $4 more than $\frac{1}{4}$ of the whole; and C has $5 less than $\frac{1}{5}$ of the whole. Find the sum divided.

8. Reduce to its simplest form

$$\frac{(\cdot 045)^3-(\cdot 015)^3}{(\cdot 045)^2+(\cdot 045)\ (\cdot 015)+(.015)^2}.$$

9. Find the value of $\frac{2}{5}$ of $(6\frac{2}{3}+2\frac{1}{2})$ of $4.80 + $\frac{2\frac{1}{4}-\frac{2}{3}\text{ of }1\frac{5}{6}}{\frac{1}{5}\text{ of }3\frac{1}{3}+\frac{13}{36}}$ of $\frac{19}{20}$ of $1.20.

10. I had a sum of money, of which I paid away $\frac{1}{5}$, then $\frac{1}{2}$ of the remainder, then $\frac{2}{3}$ of what was still left, and found that I had still left half a dollar less than $\frac{1}{5}$ of $\frac{3}{4}$ of the whole. What sum had I at first?

11. Reduce to its simplest form

$$\frac{1}{2+\frac{1}{8+\frac{1}{4}}}\text{ of }\frac{\frac{2}{13}\text{ of }\frac{1}{2}\text{ of }\frac{1}{3}\times\frac{3}{4}\text{ of }\frac{4}{3}}{\frac{7}{8}+\frac{1}{2}\text{ of }20}\times\frac{3\frac{1}{5}-2\frac{1}{3}}{5\frac{2}{7}+1\frac{1}{9}}\text{ of }23\frac{1}{3}.$$

XVIII.

1. Divide ·0078539 by ·9921461, giving the quotient to six decimal places; and find the circulating period arising from $\frac{1}{9091}$.

2. If a metric system were adopted, in which 1 ac. 1 ro. 3 per. could be represented by 5.12, express the unit of measurement in square yds. and decimal parts of a square yard.

3. Reduce $\left(\frac{2\cdot375}{3.1\dot{6}.} \text{ of } \frac{4.\dot{4}}{\cdot0625}\right) \div \left(\frac{3\cdot\dot{3}}{7} \text{ of } \frac{4}{5.625}\right)$ to a simple quantity.

4. A gentleman whose real property is ·834 of his personal property, leaves the former, amounting to $10425 to his eldest son: and the latter to be equally shared by him and two others. Find the amount received by each.

5. Find the value (in lbs.) of $\frac{\cdot\dot{1}4285\dot{7}}{4\cdot\dot{1}90847\dot{6}}$ of one ton 2 qrs. 25 lbs. $+ \frac{2\cdot375}{3\cdot1\dot{6}}$ of $\frac{4\cdot\dot{4}}{\cdot1875}$ of 2 cwt. 2 qrs. 2 lbs. $- \frac{4\cdot\dot{4}-2\cdot8\dot{3}}{1\cdot\dot{6}+2\cdot\dot{6}2\dot{1}}$ of 2 cwt 14 lbs. $- \frac{2\cdot\dot{6}}{\cdot\dot{4}}$ of 1 cwt. 1 qr. $7\frac{1}{4}$ lbs.

6. What decimal fraction of $\frac{4}{7}$ of 93 bushels 3 pks. is equal to $\frac{3}{5}$ of 78 bushels $1\frac{1}{3}$ pks.?

7. Simplify $\left(\frac{1}{\cdot01} - \frac{\cdot0009}{(\cdot4+\cdot0005)+\cdot002\times\cdot0125}\right) \div 192.$

8. Find the approximate value (to seven decimal places), of

$$\frac{1}{2} \times \frac{1}{6\times8} + \frac{1}{24\times32} + \frac{1}{5040\times128} + \frac{1}{72576\times512}.$$

9. At a school inspection ·8 of the numbers in average attendance were eligible for examination, but ·25 of them were absent; of those present and examined ·08

failed in reading, and ·14 in each of the two other subjects, Grammar and Arithmetic: the entire grant on examination was $253.44, at the rate of 64 cents for each pass. Find the number examined and the average for the year.

10. Express as a decimal the sum of $(11\frac{33}{100}-\cdot35)+(\cdot05-\frac{1}{75})$, and $\frac{7}{1\cdot25}+6\cdot007$, divided by the difference of $\frac{2}{3}(1\cdot35-\cdot72)$, and $5\cdot5004$.

XIX.

1. Two persons, A and B, finish a work in 20 days, which B by himself could do in 50 days. In what time could A finish it by himself? How much more of the work is done by A than by B?

2. A and B do a piece of work together in 6 days, and B can do a fifth of the same in a day and a half. How long would each be in doing it alone?

3. A and B can do a piece of work alone in 15 and 18 days respectively; they work together at it for 3 days, when B leaves, but A continues, and after 3 days is joined by C, and they finish it together in 4 days. In what time would C do the work by himself?

4. If A in 2 days can do as much work as C in 3 days, and B in 5 days as much as C in 4 days, how long will B require to execute a piece of work which A can accomplish in 6 weeks?

5. Two wine-glasses are filled with a mixture of spirit and water, one containing 3 parts of water and one part of spirit, and the other 4 parts of water and 3 parts of spirit. When the contents of the two glasses are mixed in a tumbler, find how many parts of the whole mixture are wine and water.

6. A cistern has 3 pipes, A, B, C; A will fill it in 3

hours, B will fill it in 4, and C will empty it in 1 hour. The cistern being empty, these pipes are opened at 1, 2, and 3 o'clock respectively. At what time will the cistern be full or empty, and which?

7. In what part of a day will four fountains, being opened together, fill a cistern, which if severally opened they would each fill it one day, half a day, the third and the sixth part respectively?

8. One clock gains 2 minutes in 3 days, and another loses 6 minutes in 7 days; if they were set right at 12 noon to-day, when will their times differ by a quarter of an hour?

9. Two clocks begin to strike 12 together; one strikes in 35 seconds, the other in 25. What fraction of a minute is there between their seventh strokes?

10. Find the different times at which the hour and the minute hand of a clock are in conjunction, in opposition, and at right angles to one another, between noon and midnight. If the hands are alike, at what times of the day might they be mistaken the one for the other?

XX.

THE METRIC SYSTEM.

1. What is the fundamental unit in the system? Whence and why was it chosen?

2. Name the units of weight and capacity, and show how larger and smaller measures are attained.

3. Give the English equivalents of a kilometer, kilogramme, and kilolitre.

4. Express the value a mile, and a gallon in kilometres, and litres.

5. How many cubic centimetres are contained in a cubic metre ?

6. A vessel measures 2 feet square and 1 foot deep, how many litres will it contain ?

7. A cubical block of ice measures 3 decimetres along its edge; what will be its weight, the specific gravity of ice being ·94 ?

8. Explain fully how units of weight, capacity, and surface have been obtained from the metre.

9. What is the weight of air in a room 5 metres long, 3 metres wide, 4 metres high, if 1 cubic decimetre of air weighs ·0018 kilogrammes ?

10. The mean height of the barometer in the latitude of Greenwich at the level of the sea is 30 inches. How many millimetres is this equivalent to ?

11. A cylindrical graduated tube 15 millimetres in diameter holds 25 cub. centimetres at 4°C. up to the hundredth division. Calculate the value in grams of one division. What will be the length between each division ?

12. Calculate the length of the polar axis of the earth on the supposition that the earth is spherical, and that the actual metre is identical with the metre as defined.

XXI.

1. Simplify $(33\frac{1}{4}+34\frac{1}{6}) \div \left(\frac{1}{5\frac{1}{5}}+\frac{1}{6\frac{1}{5}}\right)$, and $\frac{\text{4ft. 7in.}}{\text{4yds. 2ft}} + \frac{16s.\ 8d.}{17s.\ 9\frac{1}{2}d.} \div 24\frac{2}{5} + \frac{25}{1000}$.

2. Find the value of $2\frac{7}{8}$ cwt. + $37\frac{5}{8}$ lb. + $10\frac{3}{4}$ oz.

3. If the worth of $\frac{4}{15}$ of $2\frac{5}{8}$ cwt. of goods be £1 14*s.* $2\frac{2}{3}$*d.*, what is the worth of 1 cwt. 3 qrs. $17\frac{9}{10}$ lb. ?

4. A, B and C, together, are set to do a piece of work which A alone can do in 7 hours, B in 9 hours, and C in 10 hours; what time will the work require if A and B continue until its completion, but C goes away half an hour before it is finished ?

5. Find the G. C. M. of $26\frac{1}{4}$, 175, $29\frac{1}{6}$, $2\frac{11}{12}$, and $28\frac{7}{8}$; and of $\cdot1\dot{3}$, $2\cdot4$, 8, $2\cdot\dot{2}$, and $5\cdot\dot{3}$.

6. A man has $44\cdot91\dot{6}$ bushels of wheat in one bin, $42\cdot\dot{7}$ bushels of oats in another, and $38\frac{1}{2}$ bushels of barley in a third; he wishes to put up the whole, without mixing the different kinds of grain, in full bags of different size. Find the least number of bags he will require.

7. At what times between 5 and 6 are the hands of a clock $23\frac{2}{5}$ minutes apart ?

8. A piece of ground $94\frac{1}{2}$ metres long, and $46\frac{1}{4}$ broad, cost \$1850; another piece, of corresponding value, cost \$1664, its length being $86\frac{2}{5}$ metres. Find its breadth.

9. What do four pieces of silver weigh altogether, the weight of the first being ·375 of the whole, that of the second ·4 of the first, that of the third $\frac{2}{3}$ of the second, and that of the fourth 7 oz. 7 dwt. ?

10. A farm consists of arable land and pasture in the proportion of 2ac. 3ro. 14p. of the former, to 1ac. 1ro. 30p. of the latter. What is the acreage of the entire farm, if the pasture occupy $108\frac{1}{2}$ acres ?

XXII.

1. Find the L. C. M. of $10\frac{1}{2}$, $7\frac{7}{10}$, $\frac{1}{12}$, 49, and $8\frac{7}{15}$.

2. Of the candidates who presented themselves at an Entrance Examination ·375 failed in Arithmetic, $\frac{2}{3}$ of

the remainder in Geography, ·25 in the other subjects, and 10 passed. Find the whole number of candidates.

3. What average quantity of sugar is there in each of 25 casks, and what in each of 25 other casks, if the 50 casks contain 98 cwt. 1 qr. 21 lbs., and the first half of them contain 18 cwt. 2 qrs. 3 lbs. more than the second?

4. How many ounces of gold are worth £23 16*s*., when ·53 of an ounce is worth 44*s*. 2·4*d*?

5. Find to six decimal places the average of $2\frac{3}{5}$, 2·37, $3\cdot0\dot{0}\dot{6}$, 0, $2\cdot97\frac{4}{7}$, and $3\cdot\dot{5}1\dot{6}$.

6. In buying calico a man gives $\$8\frac{3}{16}$ for 20 yards, and in selling it gives 25 yards for $\$4\frac{41}{60}$; what does he gain on $100 of outlay?

7. A cistern has two supply pipes, by one of which it could be filled in $3\frac{1}{4}$ hours, and by the other in $4\frac{1}{2}$ hours. It has a discharge pipe which could empty it in 4·095 hours. Suppose the cistern empty, and all three pipes to be set open together, in what time would it be full?

8. What vulgar fraction of $\frac{15\cdot028 \text{ guineas}}{£188\cdot48}$ is equal to $\frac{2\cdot172 \text{ oz. avoir.}}{2\cdot55 \text{ oz. troy}}$?

9. If an iron bar $5\frac{2}{3}$ ft. long, $3\frac{1}{2}$ inches broad, and $1\frac{1}{4}$ inches thick, weigh $8\frac{1}{2}$ lbs.; what length of bar $3\frac{3}{4}$ inches broad, and $1\frac{2}{3}$ inches thick, weighs 138 lbs.

10. The G. C. M. of two numbers is 1259, their L. C. M. is 57700421; one of the numbers is 36268013; find the other.

XXIII.

1. Simplify $\dfrac{\frac{5}{32}+\frac{7}{24} \text{ of } 3\frac{1}{4}-(\frac{7}{16} \text{ of } \frac{37}{21}-\frac{1}{6})}{\frac{5}{28}-\frac{3}{14} \text{ of } \frac{1}{2}}$

2. Bought 1944 feet of boards at \$$20\frac{1}{4}$ per M, 3150 feet of Scantling at \$$2.87\frac{1}{2}$ per C, and 17512 of Siding at \$7.50 per M; what did the whole cost me ?

3. 40 lbs. of Standard gold, (*i.e.* 22 carats fine) are coined into 1869 Sovereigns; find the weight of pure gold in a Sovereign.

4. Bought 640 bushels of barley at the rate of 32 bushels for \$20.08, and sold it at the rate of 10 bushels for \$$8\frac{3}{4}$; find my profit on the transaction.

5. A does $\frac{3}{5}$ of a work in 11 days; B then comes to his assistance and, together, they finish it in 4 days; how long would it take each by himself to do the work ?

6. B offers C a horse for a certain price and A offers him one for one third less; B then reduces his price $\frac{3}{10}$, and A reduces his price $\frac{1}{5}$, at which prices C buys both horses for \$296; find each man's asking price.

7. Find a fraction equivalent to $\frac{5}{13}$, and having its numerator 44 less than its denominator.

8. An Agent receives 10 shillings commission for every £9 19*s.* $11\frac{3}{4}$*d.* collected; he receives altogether £9 19*s.* $11\frac{3}{4}$*d.*; find the amount collected.

9. If 4·35 lbs. of bread can be bought for 20 cents. when wheat is \$1.15 per bushel; what weight of bread can be purchased for \$3·45 when wheat is \$1·80 per bushel.

10. Find the cost of papering a room 12 ft. 4 in. high, 16 ft. long, and 14 ft. 3 in. wide, the paper being 2 ft. 6 in. wide, and costing 60 cents a yard.

11. The profits of a garden for two years were \$1456; the profits of the second year being $\frac{27}{25}$ of those of the first: find the profits of each year.

PAPERS FOR ENTRANCE

INTO

HIGH SCHOOLS AND COLLEGIATE INSTITUTES.

AUTUMN, 1873.

I.

1. By what number must £4 16*s*. $3\frac{1}{4}$*d*. be multipl to give a product of £89 17*s*. $3\frac{3}{4}$*d*. ?

2. If I own $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{2}{3}$ of a ship worth $20,000, and sell $\frac{1}{4}$ of the ship, what will the part I have left be worth ?

3. Prove the rule for multiplication of fractions.

Simplify $$\frac{1\frac{2}{11}}{1\frac{3}{5}} \div \left(\frac{2\frac{7}{11}}{4\frac{4}{10}} - \frac{1\frac{3}{4}}{3\frac{1}{4}}\right) + 3\frac{1}{2}.$$

4. If A can do a work in $3\frac{3}{4}$ days, and B in $4\frac{1}{2}$ days, in what time will both working together do the work ?

5. If the 2 lb. loaf cost $6\frac{3}{4}$ cents, when wheat is $1.10 a bushel, what is the price of wheat when the 2 lb. loaf costs $7\frac{1}{2}$ cents ?

6. Simplify $$\frac{3\frac{1}{2} - .04}{5 - .0625} \div \frac{.015 + 2.1}{.035}$$

7. Find the expense of fencing a railway (both sides) 73 miles in length, at the rate of $5.50 per rod.

8. If a wheel make 260 revolutions in passing over one mile, 520 yards, 2 feet, what is its circumference ?

9. Find cost of 7,225 lbs. coal at \$7.25 per ton of 2000 lbs.

10. Find the sum and difference of $2754\frac{15}{323}$ and $2633\frac{12}{54}$.

JANUARY, 1874.

II.

1. By what must £157 12*s.* 10½*d.* be divided to give a quotient of 33½ ?

2. How much wheat is necessary to sow a field containg $7\frac{3}{4}$ acres if $\frac{3}{4}$ of an ounce is sown on every square yard ?

3. How many minutes between 12 o'clock noon May 24th, and half-past nine in the forenoon of September 3rd ? and express the answer as a fraction of the year.

4. Add $(1\frac{4}{5}$ of $\frac{9}{13})$, $(\frac{3}{8}$ of $1\frac{17}{18})$, $\left(\frac{\frac{16}{6}}{\frac{22}{9}}\right)$.

5. A house and lot cost \$3600; the value of the lot is $\frac{1}{5}$ that of the house. Find the value of each.

6. Subtract $2\frac{7}{800}$ sq. yards from $\frac{7}{9}$ of $\frac{3}{14}$ of 3 acres.

7. Prove that multiplying the numerator of a fraction by any number produces the same effect as dividing the denominator by the same number.

8. Simplify

$$.75 \text{ of } 1\tfrac{1}{3} \div 7.6 \text{ of } \tfrac{6}{76} - (1.875 - 1\tfrac{5}{8}) \times 2 + \frac{4.875}{4\frac{7}{8}}$$

9. If $\frac{2}{3}$ of $\frac{4}{7}$ of an acre produce 43 bushels of potatoes, how many bushels will an acre produce ?

10. If a man working $9\frac{3}{4}$ hours per day finishes a piece of work in 6 days ; in what time would he have finished it if he had worked $8\frac{1}{2}$ hours per day ?

JUNE, 1874.

III.

1. The *dividend* is one billion two hundred and twenty million two hundred and thirty thousand and ninety-two, the *quotient* six thousand and eighty-four, and the *remainder* forty-eight thousand. Find the divisor.

2. Reduce 3 ac. 2 ro. 14 sq. pr. 4 sq. ft. 72 sq. in. to square inches; and 170184 square feet to acres.

3. 797 tons 19 cwt. 2 qrs. 14 lbs. is divided among a certain number of people, so that each receives 5 tons 3 cwt. 2 qrs. 16 lbs. How many people are there?

4. Shew which is the greatest and which the least of the following fractions :—$1\frac{1}{7}$ of $\frac{1}{4}$, $\frac{5}{21}$ of $3\frac{1}{2}$, $\frac{1}{3}$ of $2\frac{3}{8}$.

5. Reduce to its simplest form—

$$\left\{\frac{2\frac{1}{4}-\frac{2}{3}\text{ of }1\frac{5}{6}}{\frac{1}{3}\text{ of }3\frac{1}{5}+\frac{6\frac{1}{2}}{18}}+\frac{1}{2\frac{1}{2}}\right\}\div\frac{5\frac{1}{4}}{8\frac{3}{4}}$$

6. What fraction of £58 5*s*. 6*d*. is $\frac{36}{37}$ of £17 2*s*. 3*d*.?

7. A man invested $\frac{2}{5}$ of his capital in bank stock, $\frac{3}{4}$ of the remainder in real estate, and had still $6000 left. Find his capital.

8. Find the value of 43 cwt. 2 qrs. 21 lbs. at £2 16*s*. 8*d*. per cwt. (Qr.=25 lbs.)

9. Find the difference between

$$\frac{.26+.2\text{ of }3.7}{.48-.014\text{ of }20}\quad\&\quad\frac{4.\dot{3}+5.\dot{6}}{7.\dot{4}-.\dot{2}\text{ of }11}$$

10. A person, after paying out of his income for a year a tax of 4 cents in the dollar, has $7200 left. Find his income for a year.

DECEMBER, 1874.

IV.

1. The difference between the product of two numbers and 476 is ten millions, ten thousand and ten; one of the numbers is twenty-one thousand and twenty-eight; what is the other number?

2. A cannon ball travels at the rate of 1,500 feet in a second and a half; how far will it have gone in $\frac{11}{15}$ of a minute?

3. How many grains are there in 9 oz. 17 dwt. 22 grs., and how many acres, &c., in 167412715 square inches?

4. How many yards, &c., of carpet 2 ft. 1 in. wide, will it take to cover a floor that is 19 ft. 7 in. long by 18 ft. 9 in. wide?

5. After taking out of a purse $\frac{2}{5}$ of its contents, $\frac{2}{3}$ of the remainder was found to be 13*s.* 5½*d.* What sum did it contain at first, and what part of £3 is that sum?

6. Find the value of

$$\frac{5\frac{5}{8} \div \frac{2}{3}}{1\frac{1}{5} \text{ of } \frac{5}{9} \div 10\frac{1}{3}} \times \frac{3}{5} \text{ of } \frac{1\frac{1}{2} \text{ of } 4\frac{1}{9}}{13\frac{7}{8} \text{ of } 5\frac{1}{3}}.$$

7. What must be the length of a plot of ground, if the breadth is $15\frac{3}{4}$ feet, that its area may contain 46 sq. yards?

8. A pint contains $34\frac{2}{3}$ cubic inches; how many gallons of water will fill a cistern 4 ft. 4 in. long, 2 ft. 8 in. broad, and 1 ft. $1\frac{1}{2}$ in. deep?

9. Reduce to a simple quantity

$$\frac{2.8 \text{ of } 2.\dot{2}\dot{7}}{1.1\dot{3}\dot{6}} + \frac{4.4 - 2.8\dot{3}}{1.\dot{3} + 2.\dot{6}2\dot{9}} \text{ of } \frac{6.8 \text{ of } 3}{2.25}.$$

10. The chain for measuring land is 66 ft. long, and is divided into 100 links; what is the length of a fence that measures 2456 links, and how much would it cost at $8.86 per yard?

JUNE, 1875.

V.

1. Reduce to its lowest terms

$$\left(\frac{2\frac{1}{4}-\frac{2}{3}\text{ of }1\frac{5}{6}}{\frac{1}{3}\text{ of }3\frac{1}{2}+\frac{13}{36}}-\frac{1}{2\frac{1}{2}}\right)\div\frac{1}{1\frac{2}{3}}$$

2. A merchant bought a number of barrels of flour for $4600, and sold them for $5200, thereby gaining 75 cents a barrel; how many barrels did he buy, and what did it cost him a barrel?

3. A paid $60 an acre for his farm, which was $\frac{3}{5}$ as much as B paid per acre for his farm of 150 acres. Find the entire cost of B's farm.

4. Find the sum of $\frac{1}{12}$ of £1 13*s*. 0½*d*. + ⅓ of £1 5*s*. 8½*d* + $\frac{1}{12}$ of £2 4*s*. 8¾*d*.

5. A farmer having 17 cwt. 2 qr. 19 lbs. of pork, sold 4 cwt. 3 qr. 21 lbs. of it, and the remainder he sold in barrels, each containing 2 cwt. 6⅛ lbs.; how many barrels did he sell? 6 $\frac{216}{1237}$

6. If it take a man 1 hour and 40 minutes to cut ½
✗ a cord of wood, for how many days of 8 hours each will be occupied in cutting 186 cords 88 feet?

7. A man invests ⅓ his fortune in land, $\frac{1}{7}$ in bank stocks, ⅙ in debentures, and loses the remainder, which was $8,000 in speculation; how much was his fortune?

8. The *dividend* is fifty-one million eight hundred and forty-six thousand seven hundred and thirty-four,

the *quotient* is five hundred and eight thousand three hundred and one, and the *remainder* 23; find the *divisor*.

9. Find the cost of $49\frac{3}{11}$ yds. of cloth, when $7\frac{5}{8}$ yds. cost £7 18*s.* 4*d.*

10. A man paid $2,896,875 for land, and sold 56.25 acres at $31 an acre; the remainder then stood him at $20.05 an acre; how many acres did he buy?

December, 1875.

VI.

1. Find the amount of the following account:—
Mr. Markham bought of Mr. Jones, Dec. 8, 1875,

12	yards Scotch Tweed,	@	$2.85.
16	yards of Silk,	@	2.12½.
50	yards Ticking,	@	14½.
42	yards Shirting,	@	16½.
12½	yards Flannel,	@	50.
20¼	yards Scotch Plaid,	@	60.

2. I bought from A 97 acres 2 roods and 12 square rods of land; from B, four times as much, less 7 acres and 1 rood; and from C, ½ as much as from A and B together. I then sold 120 acres 1 rood and 29 sq. rods. How much had I left?

3. Reduce to its simplest form

$$\left(\frac{13\frac{1}{3}}{28}+\frac{\frac{1}{4}}{2\frac{5}{8}}-\frac{15}{54}\text{ of }\frac{\frac{1}{2}}{\frac{7}{8}}\right)+5\tfrac{1}{4}.$$

4. State the rule for division of Vulgar Fractions, and show by means of an example the reason for it.

5. A person bought a certain number of barrels of flour for $2200; he reserved 20 barrels for use and

sold $\frac{4}{5}$ of the remainder for \$1976, which was \$304 more than cost. Find the number of barrels he bought.

6. A sum of money is divided among 4 persons. The first receives $\frac{1}{3}$, the second $\frac{1}{4}$, the third $\frac{1}{5}$, and the fourth the remainder. It is found that the first received \$700 more than the fourth. Find the sum received by each.

7. Add together $\frac{3}{5}$ of £3 7*s*. 6*d*. and $\frac{2}{3}$ of $\frac{1}{4}$ of $4\frac{1}{6}$ guineas, and reduce the result to the fraction of £1 10*s*.

8. If the annual rent of 46 acres 3 roods 14 perches of land be \$370.70, how much will be the rent of 70 acres and 20 perches?

9. If the price of 1.875 pounds of tea is 1.3749 shillings, how much can be bought for £15 8*s*.?

10. A hall is 45 feet long and $11\frac{1}{4}$ feet wide; what will it cost to carpet it (1) with carpet 27 inches wide and \$1.75 per yard; (2) with carpet 45 inches wide and \$1.25 per yard?

JUNE, 1876.

VII.

1. Bought $19\frac{1}{2}$ yds. Irish linen at 5/4, $16\frac{3}{4}$ yds. calico at 1/8, and $16\frac{1}{2}$ yds. of silk at 8/4; find the amount of the bill in dollars and cents.

2. Add together $\frac{3}{4}$ of $\frac{5}{8}$ of £2. 5s., $\frac{2}{7}$ of 3 guineas, and $\cdot\dot{2}\dot{7}$ of £1 18s. 6d., and reduce the result to the decimal of £25.

3. If a pipe discharge 2 hhd. 23 gal. 2qt. 1pt. of water in one hour, in how many hours will it discharge 11 hhd. 25 gal. $1\frac{3}{8}$ pt., the water flowing with the same velocity?

4. Add together, $\frac{16}{\frac{7}{15}\text{ of }2\frac{8}{11}\times\frac{11}{35}}$, $\frac{\frac{1}{2}\frac{3}{7}}{1\frac{2}{9}\text{ of }3\frac{9}{10}}\times\frac{1}{\frac{5}{11}}$,

and divide the result by $\frac{8\frac{2}{3}\text{ of }5\frac{1}{4}\text{ of }7\frac{1}{3}}{63}-\frac{1}{8\frac{1}{3}}-\frac{\frac{4}{17}\times\frac{3}{14}}{\frac{1}{8}}$.

5. A man's annual income is \$2,400; find how much he may spend per day so that after paying a tax of 2 cents 7½ mills on every dollar of income he may save \$582 a year (365 days).

6. A room is 36 feet long and 24 feet wide; find the difference in the expense of carpeting it with carpet a yard wide at \$1.40 a yard, and with carpet 27 inches wide at \$1.15 a yard.

7. If 162 gallons of water will fill a cistern 4 ft. 4 inches long, 2 ft. 8 inches broad, and 2 ft. 8 inches deep, how many cubic inches are contained in a pint?

8. Three men can mow a field in 6 days; they mow together for two days, and then one of them ceases work, and the other two finish the field in 7 days; find how long the man who ceased work at the end of the second day would have taken to mow the whole field by himself.

9. A man sold two city lots for \$600 each; on the one he gained ¼ of the price it cost him, and on the other he lost ¼ of the price it cost him; find his entire loss on the sale of the two lots.

10. A drover bought a number of cattle for \$4375, and sold a certain number of them for \$43 a head for the total sum of \$3655, gaining \$680, for how much per head must he sell the remainder so as to gain \$400 more.

DECEMBER, 1876.

VIII.

1. How many square inches are there in 3 ac. 2 ro. 27 pr. 27 sq. yds. 7 sq. ft. 23 sq. in.; and how many tons, cwt., &c., in 87,496 pounds and 4763 ounces?

2. A person owns $\frac{3}{8}$ of a ship, and sells $\frac{3}{8}$ of his share for £1260. What is the value of the ship?

3. The difference between the product of two numbers and 2431 is three hundred millions, three hundred and three thousand and three. One of the numbers is twenty thousand three hundred and six. Find the other.

4. Show which is the least and which the greatest of the following fractions:—

$\frac{1}{9}$ of $9\frac{1}{9}$, $\frac{82}{90}$ of 9, and $\frac{20}{82}$ of 8.2.

5. If telegraph posts are placed 80 yards apart, and a train passes one every 4 seconds; how many miles an hour is it running?

6. A regiment marching $3\frac{1}{2}$ miles an hour takes 110 steps in a minute. What is the length of the step?

7. How many yards of carpet 15 inches wide will cover the floor of a room $22\frac{1}{2}$ ft. by 19 ft.?

8. Simplify $83 - 1\frac{7}{9}$ of $2\frac{5}{20}$ of $1\frac{1}{5} + 2\frac{1}{2} \div \frac{3}{14} - 7$.

9. Find the sum of $6{\cdot}2\dot{7}$, $18{\cdot}\dot{6}5\dot{1}$, and $12{\cdot}\dot{3}4\dot{5}$, and the difference between ${\cdot}3402\dot{7}$ and ${\cdot}2\dot{7}$.

10. If a room be 12 ft. square, what must its height be in order that the area of the walls may amount to 60 sq. yds.?

IX.

1. Multiply $\dfrac{1-\frac{13}{25}}{3\frac{1}{3}+\dfrac{2\frac{3}{4}}{\frac{4}{5}}}$ by $\left(\dfrac{1+\frac{2}{3}}{1-\frac{2}{3}}\right)^2$, and subtract

$$\frac{3\frac{4}{5}+\frac{29}{45}}{3\frac{3}{4}+14\frac{1}{36}} \text{ from } \frac{7\frac{1}{2}+1\frac{17}{27}}{3\frac{2}{3}+3\frac{23}{33}}.$$

2. At what time will the hour and minute hands of a watch be together between 3 and 4?

3. "The Crystal Palace at Sydenham has the largest clock in the world; the minute hand is 19 feet in length, and moves half an inch in every beat of the pendulum, and its point travels nearly four miles a week." The ratio of the circumference of a circle to its diameter being 3.1416, find the exact distance travelled by the minute hand; also show that every beat of the pendulum measures a little less than *four-fifths* of a second.

4. Express $.3\dot{3}$ of 13*s.* 4*d.*+$.13\dot{3}$ of £1. 4*s.*, as a decimal of £5; and divide 3.064 by $.34\dot{6}+\frac{20}{7}$ of $.291\dot{6}$.

5. A man leaves ½ his property to his wife, a sixth part to each of two children, a twelfth to his brother, and the rest, amounting to $3,000, to charitable purposes. Find the amount of his property.

6. The weight of lead is $\frac{19}{35}$ and that of copper $\frac{29}{70}$ of an equal bulk of platinum. How many cubic inches of lead will be equal in weight to a cubic foot of copper?

7. Find the G.C.M. of 860149 and 2006153.

8. Which is the heavier, a pound of gold or a pound of feathers, and an ounce of gold or an ounce of feathers? By how much in each case?

9. A man died in 1873, aged 44; his son died in 1877, aged 17. How old was the father when the son was born?

10. A firm turns out 50 tons of steel goods per week, using up for that purpose 51 tons of iron, at $27 per ton, 100 tons of coal at $2.70 per ton, and $180 worth of other materials; expenses are $300 a week, and rent, taxes, &c., are $876 a year; at how much per cwt. must the steel be sold to give neither profit nor loss?

X.

1. Define the L. C. M. and the G. C. M. of two or more numbers. The G. C. M. of two numbers is 537, and the L. C. M., 18795; if one of them is 105 times $\frac{2\frac{6}{7}}{4\frac{5}{6}}$ of $\frac{363.37}{8.4}$ find the other.

2. Reduce 22870054 square inches to acres.

3. A farmer sold 1140 lbs. of wheat and 782 lbs. of oats for $29.75, receiving 35 cents a bushel more for the wheat than for the oats; find the price of each per bushel.

4. What part of half a crown is

$$\frac{1}{7} \text{ of } \frac{2\frac{1}{4}-\frac{2}{3} \text{ of } 1\frac{5}{6}}{\frac{1}{5} \text{ of } 3\frac{1}{3}+\frac{13}{36}} \text{ of } \frac{2}{11}$$

of two guineas and a half?

5. The length of a wall is, according to the French metric system, 18 metres, 9 decimetres, 6 centimetres; find its length in English feet, the length of the metre being 39.371 inches.

6. Bought 290 acres of land for $9860, and sold a part of it for $10000 at $40 an acre; how many acres had I remaining, and how much did I gain on every acre sold?

7. Show that the value of a fraction is not changed by multiplying or dividing both its terms by the same number.

8. A man and a boy engaged to do a piece of work for $21; when $\frac{3}{8}$ of the work was done the boy went away, leaving the man to finish it alone, the result being that the work occupied a day and a quarter more than it would have done; the boy was able to do in a given time only half as much work as the man, and was paid accordingly; find how much the man earned per day.

9. If the price of a farm of 80a. 1r. 10p. be $3925.12½, what will be the price of another farm containing 60a. 15p., if 3 acres of the latter be worth 4 of the former?

10. A rectangular cistern whose length is 13 ft. 4½ in., and breadth 6 ft., contains 294¼ cubic ft. of water; find the depth of the cistern, and the weight of water if one cubic inch weighs 252.5 grains.

XI.

1. A persons income is reduced from £750 to £734 7*s.* 6*d.* by income tax. How much does he pay in the pound?

2. A laborer receiving wages at the rate of $6 a week through the year, saved 20 cents a week, which he deposited in the savings bank. In consequence of a strike his wages were raised 80 cents a week, but he found at the same time that with the cost of living, and his payment to the trades' union, he had to pay 50 cents, where he formerly paid 45 cents; find the increase in his yearly savings.

3. The fore and hind wheels of a carriage are 12

and 15 feet in circumference; find the least number of revolutions of each wheel which will give the same length.

4. What is meant by an improper fraction and what by a mixed number? How are improper fractions converted into mixed numbers, and conversely?

5. The sum of $\frac{2}{3}$ and $\frac{4}{15}$ is diminished by $\frac{1}{10}$; how often does the difference contain $\frac{3}{11}$ of the sum of $\frac{1}{8}$, $\frac{1}{9}$ and $\frac{1}{10}$?

6. What length of carpet $\frac{3}{4}$ yard wide will cover a room whose length is 42 feet 5 inches, and breadth $31\frac{3}{4}$ feet?

7. Explain whether .067 or .068 is more nearly equal to .06748, and express in words the error in excess or defect in each case.

8. A tea dealer has teas worth 90 cents and 60 cents per pound, respectively, which he mixes, taking two pounds of the former to one pound of the latter, and sells the mixture at 85 cents per pound; what does he gain or lose per cwt.?

9. If 4 men *or* 6 women can do a piece of work in 20 days, how long will it take 3 men *and* 15 women to do the same work?

10. If a garrison of 1500 men have provisions for 13 months; how long will their provisions last, if it be increased to 2200?

XII.

1. Simplify $\dfrac{26\frac{3}{7}-1\frac{13}{21}}{\frac{4}{5}+1\frac{1}{3}-\frac{1}{3}}$ of $\dfrac{122\frac{7}{64}}{206\frac{1}{2}}$ and divide $75.0\dot{7}\dot{8}$ by $91.8\dot{6}\dot{3}$.

2. Does every interminate decimal circulate? Prove

the rule for converting a "mixed" circulating decimal into a vulgar fraction.

3. On the 7th of August I lent a friend $1600, which he retained until the 6th of October following; my friend afterwards returned the compliment by lending me $1200 on the 15th of March; when should he get back his money?

4. A block of oak a foot square and 6 feet long has round it two bands of iron, each 3 inches broad and 1 inch thick; find the weight of the whole, a cubic foot of oak weighing 58.37 lbs., and of iron 486.72 lbs., (cwt. = 112 lbs.).

5. The distance from Toronto to London via the G. W. R. is $119\frac{1}{2}$ miles; the distance from Toronto to Hamilton is $\frac{79}{160}$ of the distance from Hamilton to London; find the distance from Toronto to Hamilton, and from the latter place to London.

6. If $\frac{9}{14}$ of a meadow be mown by 12 men in 6 days, find in what time the remainder could be mown by 10 men.

7. Subtract the cube of the difference of $\frac{5}{12}$ and $\frac{1}{6}$ from the difference of their cubes, and divide one-fourth of the result by $\frac{2}{3}$ of the product of their squares.

8. A has 50 shillings, B has 56 francs; how many francs must B give A in order that his money might be one-sixth of A's, a franc being $\frac{25}{28}$ of a shilling?

9. A runs at the rate of $266\frac{2}{3}$ yards a minute, and B at the rate of 275 yards a minute; how much start may one give the other so as to win by a yard in a mile race?

10. A man who rows four miles an hour in still water takes 1 hour and 12 minutes to row that distance

up a river; how long will he take rowing down again?

XIII.

1. Find the amount of the following bill; 34 lbs. 14 oz. beef @ 17 cts.; 14 lbs. 10 oz. mutton @ 19 cts.; 7 lbs. 6 oz. pork chops @ 21 cts.; 15 lbs. 7 oz. lamb @ 29 cts.; 8 lbs. 9 oz. suet @ 16 cts.

2. Fifty-nine lbs. of a mixed metal are lowered into a full bucket of water, and the water which overflows is found to measure 195 cubic inches; find the weight of half a cubic foot of the metal (supposing a cubic foot of water to weigh $62\frac{1}{2}$ lbs.), and its value at $1.20 per lb.

3. A postmaster is allowed one dollar and a quarter on every hundred dollars' worth of stamps he sells; find his gain on a sale of 1000 three cent stamps.

4. What must be added to

$$\frac{1\frac{1}{2} \text{ of } 3\frac{1}{3}}{3\frac{1}{2} \text{ of } 2\frac{2}{3}} \text{ of } \frac{1\frac{3}{7} \text{ of } 1\frac{1}{6}}{1\frac{2}{7} \text{ of } \frac{32\frac{2}{3}}{3\frac{1}{2}}} + \frac{2\frac{1}{8} \text{ of } 6\frac{2}{3}}{3\frac{1}{3} \text{ of } 4\frac{1}{2}} \text{ to make it}$$

equal to $\frac{1}{28\frac{2}{7}}$ of $3\frac{1}{7}$ of $1\frac{5}{7}+\frac{3}{8}$?

5. Simplify $\dfrac{\cdot17 \text{ of } (\cdot00617-\cdot00532)+\cdot119\times\cdot007}{\cdot17\times\cdot17}$

6. Five-ninths of all the pupils in a public school were below the fourth-class; $\frac{5}{7}$ of those above the third class went up to the Entrance examination, of whom 8 failed to pass, and the number successful was $\frac{3}{7}$ of the number above the third class; find the total number in the school.

7. A person after paying 7*d.* in the pound income tax has left a net income of £526 8*s.* 10*d.*: how much tax did he pay?

8. Find the weight of a bar 3 yds. 1 ft. 9 in. long, of which a yard weighs 15 lbs. 7 oz. 8 drs.

9. If I buy 147 gal. 3 qt. of molasses at 25 cents a gallon, and use 38 gallons of it, at how much must I sell the remainder per gallon so as to receive as much as the whole cost?

10. A and B can build a wall in 30 days, and A does twice as much as B; how long will it take each to build it?

XIV.

1. Find the yearly average of profits or losses in seven years, of a merchant who gained on the first, third, fourth and sixth years the sums of $2080, $800, $2800, and $4000; and lost in the second, fifth and seventh years, $400, $1000, and $1280, respectively.

2. Divide $4000 among three persons, so that the first may have three times as much as the second, and the third as much as the first and second together.

3. There is in a manufactory a certain number of workmen who receive $10 a week, twice as many who receive $6.30 a week, and eleven times as many who receive $2.80 a week, and the total amount of workmen's wages for one week is $373.80; find the number of workmen.

4. If a cent piece is one inch in diameter, how many can be laid in rows touching each other on a table which is 7 ft. 6 in. long and 3 ft. 4 in. wide?

5. A cask is required which can be filled exactly by any one of the following measures, taken any number of times exactly; half a pint, half a gallon, three gallons, 5 gallons, and nine gallons; find the smallest cask for this purpose.

6. If $\frac{2}{3}$ of an inch on a map corresponds to 7 miles of a county; what distance on the map represents 20 miles?

7. Reduce $\frac{23}{15}$ of an ounce to the decimal of a pound Troy.

8. In a certain school $\frac{1}{3}$ the scholars study arithmetic, $\frac{1}{4}$ algebra, $\frac{1}{5}$ geometry, and the remainder of the school, viz., 10 scholars, study classics; how many scholars are there in the school?

9. A piece of land is 68.5 rods long and 27.75 rods wide; what will it cost to fence it, at $87\frac{1}{2}$ cents per rod?

10. A cistern has 3 pipes; the first will fill it in 3 hours, the second in 4 hours, and the third in five hours. In what time will they together fill the cistern?

XV.

✓ 1. How many silver spoons, each weighing 2 oz. 16 dwt., could be made out of a bar of silver, the weight of which is 50 oz. 8 dwts.?

2. Find the united area of the walls of a room which is 16 ft. [illegible] in. high, 14 ft. 7 in. in width, and 40 ft. 2 in. long. Also, find how much paper 25 in. wide will be required to cover them.

3. What is the least number from which 2, 4, 8, 10, 13, 17, 7, 84, 16, 91, and 510 may each be taken an exact number of times?

4. Find the difference between

$$\frac{\frac{2}{3}\text{ of }.005}{\frac{1}{12}\text{ of }.345}\quad\text{and}\quad\frac{2}{3}\text{ of }\left(\frac{11}{39}-\frac{1}{130}\right)\div\left(.72+\frac{11}{120}\right).$$

5. The ratio of the *vibrations* of a pendulum to the *number of seconds in which the vibrations are made*, is $\frac{1\frac{2}{3}}{\frac{2}{3}}$; how many times will it vibrate in 24 hours?

6. The weight of a cubic inch of water is 253.1 grains, that of a cubic inch of air is .310017 grains; how many cubic inches of air are equal in weight to one cubic foot of water?

7. Find the value of

$$\frac{1}{1\times2\times3}+\frac{1}{2\times3\times4}+\frac{1}{3\times4\times5}+\frac{1}{4\times5\times6}$$

correct to four decimal places.

8. A man bought 296 sheep at \$5.50 per head, and after paying $\frac{2}{11}$ of his outlay in expenses, exchanged them for 37 oxen, which he sold immediately at \$60 a head; how much did he gain on every hundred dollars of his expenditure?

9. Find the difference in cost between 600 ft. of chain cable, weighing 76 lbs. to the foot, and 1800 ft. of wire rope, weighing 18 lbs. to the foot, the chain cable costing 15s. 6d. per cwt., and the wire rope £1 3*s*. 6*d*. per cwt.

10. Divide \$153.60 among A, B and C., so that B may have two-thirds as much again as A, and C three-fifths of what A and B together have.

XVI.

1. Subtract $\dfrac{7\frac{1}{2}}{8\frac{1}{3}}$ bushels $+\frac{5}{8}$ of $\frac{56}{75}$ of $3\frac{1}{3}$ qt. from 5 bushels $+3\frac{3}{4}\frac{1}{5}$ qt.

2. A man expended \$280.60 in purchasing rye at 95 cts. a bushel, wheat at \$1.37 a bushel, and corn at 73cts. a bushel, buying the same quantity of each; find the entire number of bushels purchased.

3. Divide the difference of $13\frac{1}{3}\div\{(2\frac{6}{7}-2\frac{8}{11})\times1\frac{4}{7}\}$ and $13\frac{1}{3}\div(2\frac{6}{7}-2\frac{8}{11})\times1\frac{4}{7}$ by $13\frac{1}{3}\div2\frac{6}{7}-2\frac{8}{11}\times1\frac{4}{7}$.

4. Find the L. C. M. of 11, 14, 28, 22, 7, 56, 27, 81, 54, and 36; and the G. C. M. of 13515 and 13787.

5. After the losses sustained in two engagements, a detachment of cavalry was found to consist of 1040 men; in the first engagement they lost one man in every twenty-five, and in the second $\frac{5}{18}$ of the remainder; find the number of men originally in the troop.

6. Divide the sum of $(11\frac{13}{100}-.35)\div(.05-\frac{1}{75})$ and $(\frac{7}{125}+6.007)$, by the difference between $\frac{2}{3}(1.35-.72)$ and 5.0004.

7. The earth's polar diameter contains 41,707,796 feet, and the difference between the equatorial and the polar is one 292nd part of the latter; find the difference between the two in miles.

8. A man sold 24 horses for $150 each; on half of them he gained $\frac{3}{10}$ of what they cost, and on the remainder he lost $\frac{1}{5}$ of what they cost; find his whole gain or loss.

9. The standard gold coin of Great Britain is made of gold 22 carats fine, and a pound Troy of this metal yields $46\frac{29}{40}$ sovereigns; find the weight of pure gold in 100 sovereigns.

10. Make out in proper form (giving the amount) a bill of the following sales: Jno. Jones bought of R. Jaffray, July 10, 1877, 10 yds cassimere @ $2.85; 16 yds. silk at $1.12½; 727 yds. ticking @ 14 cts.; 42 yds. shirting @ 16½ cts.; 12 yds. flannel @ 40 cts.; 24½ yds. print @ 56 cts.

XVII.

1. If the pound Avoirdupois contains 7000 grains, find the greatest weight which will measure both a

pound Troy and a pound Avoirdupois; and the least weight which can be expressed without fractions in both pounds Troy and pounds Avoirdupois.

2. If a boy's school life lasts seven years, and he has 4 weeks 3 days holidays at Christmas, and 5 weeks $2\frac{1}{2}$ days at midsummer; how many holidays has he in 7 years?

3. Multiply £6 11*s.* $3\frac{7}{8}$*d.* by $13\frac{7}{8}$.

4. What sum must A bequeath to B, so that B may receive $1000 after a legacy duty of $10 per cent. has been deducted?

5. A creditor receives $1.50 for every $4 of what was due to him, and thereby loses $301.05. What was the sum due?

6. Of a field $\frac{1}{3}$ is meadow, $\frac{3}{5}$ arable land, and the remainder is 1 acre, 3 roods, 26 poles; find the quantities of meadow and arable land.

7. What must be given per yard for carpet 27 inches wide, that the carpeting of a room 26 feet long and 15 feet 8 inches broad may cost $180?

8. Find the value of

$$\frac{4\frac{4}{15}\text{ of }2\frac{3}{8}}{5\frac{1}{3}-4\frac{1}{5}}\text{ of }\$40.$$

9. Find the value of

$$\frac{3.0005\times.006}{.0009}$$

10. Which is the cheaper, a hat which cost $3, and will last 9 months, or one which cost $2.40, and will last 7 months? And how much will a man save in 20 years who wears the cheaper kind of hat, interest not being reckoned?

XVIII.

1. Shew that the fraction $\frac{10+12}{12+14}$ is greater than $\frac{5}{6}$ and less than $\frac{6}{7}$.

2. A person buys 64 lbs of meat weekly; for 16 weeks the price is 17 cts, per lb., for 26 weeks 16 cts., for 10 weeks 15 cts.; what is the amount of his butcher's bill, and the average price per lb. during the year?

Reduce to its simplest form

$$\frac{1+\frac{2}{3}\text{ of }\frac{1}{4}+1\frac{2}{3}}{\frac{2}{13}\text{ of }(1+5\frac{1}{2})+1\frac{2}{3}\text{ of }\frac{2}{23}\text{ of }(7-2\frac{2}{5})-\frac{2}{3}}\text{ of }\frac{2}{17}.$$

4. Find the value of

$$8{\cdot}\dot{3}\text{ of }\frac{4{\cdot}\dot{4}}{.\dot{7}3\dot{5}}\text{ of 2 sq. ft. 6 sq. inches.}$$

5. A person has four creditors; to the first he owes $1248, to the second $1092, to the third $984, and to the fourth $736; he fails, and the creditors seize the whole amount of his property, which amounts to only $1640; how ought this sum to be divided amongst them?

6. By selling cigars at the rate of $2:60 for 4 dozen it was found that $\frac{5}{8}$ of their cost was gained; find the price at which each cigar ought to have been sold in order to gain $\frac{7}{10}$ of the original cost.

7. Gunter's chain consists of 100 links, and ten square chains make an acre. Find the area of a rectangular field whose breadth is 78 chains 23 links, and length 85 chains 40 links.

8. A person expended \$55.92 in tea at 87½ cts. per lb., coffee at 18¾ cts., and sugar at 10¼ cts., buying an equal quantity of each; how many pounds of each did he buy?

9. Find the duty on 4 hogsheads of sugar, each weighing 1280 lbs. gross, at 2¾ cts. per lb., $\frac{1}{50}$th of the gross weight being allowed for tare.

10. A clock gains 8¼ minutes in 15 seconds less than 24 hours; at noon it is 2 minutes too slow; when will it indicate true time?

XIX.

1. Find the difference between 1000 Avoir. oz. and 1000 Troy oz., and arrange the remainder in parcels of 2½ dwts. each. How many parcels are there if 17000 grs. make a lb. Avoir. wt.?

2. \$90.90 are shared among 4 men, 5 women, and 6 children, so as to give to each man twice as much as to each woman, and to each woman three times as much as to a child. What do the women get?

3. A sheep-dealer bought sheep to the value of \$9,000 and after keeping them 4 weeks and paying 50 cents. each for their pasture during that time, sold the whole for \$14,000 and thereby cleared \$2.00 per head. How many sheep did he buy?

4. If $\frac{2}{7}$ of $1\dot{3}$ of $\dfrac{1\frac{2}{3}}{8\frac{1}{7}}$ of a ship is worth \$500, what should be paid for 25 of it?

5. James received a present of some money. He gave $\frac{1}{3}$ of it to his sister, and $\frac{3}{5}$ of the remainder to his brother, and kept the rest, \$4, to himself. How much did he receive, and how much did his brother get?

6. James can dig a garden by himself in 8 days,

John can also dig it alone in ten days. The owner is going to pay $27 for the digging. If they dig together, what should each receive ?

7, Little Jane has a card board 21 in. long and 15 in. wide, which she wishes to cover with postage stamps $1\frac{1}{4}$ in. long and $\frac{7}{8}$ inches wide, and wishes to know how many it will take to do it. Make the calculation.

8. How many times will a carriage wheel 4 ft. 8 in. in diameter turn in going 1 m. 1 fur. 1 per. ? The circumference of a wheel is $3\frac{1}{7}$ times the diameter.

9. A person owns a ship and its cargo valued at $6000. $\frac{1}{3}$ of the value of the cargo is equal to $\frac{1}{3}$ that of the ship. What is the value af each ?

10. How many bushels of potatoes can be sold out of a garden in which there are 160 rows of potatoes, in each row 240 hills, and on an average 10 potatoes in each hill, if 6 potatoes make a pint ?

XX.

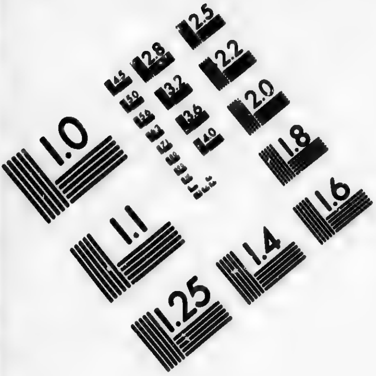
1. A farmer bought land from A at 60 dollars an acre, and the same quantity from B at 85 dollars an acre. The whole amounted to 53215 dollars. How many acres did he buy from each ?

2. A farmer has 66 bushels of corn, and 90 bushels of wheat, which he wishes to put into sacks of equal size, and without mixing the two kinds of grain. How many bushels must each sack contain ?

3. Define a fraction. Explain how it is that the product of two proper fractions gives a fraction less than either of them, and the quotient a fraction greater than the dividend.

4. Reduce to its simplest form :

$$\left\{\frac{15}{4}-\frac{14}{15}+\frac{13}{14}-\frac{11}{12}\right\}\times\left\{\frac{7}{12}+\frac{5}{16}+\frac{8}{21}+\frac{11}{80}\right\}$$



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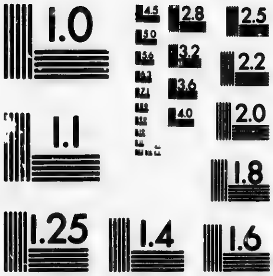

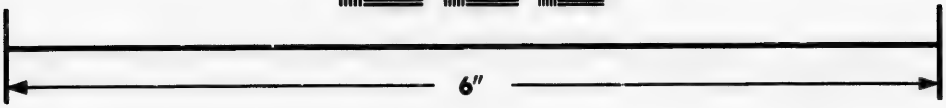

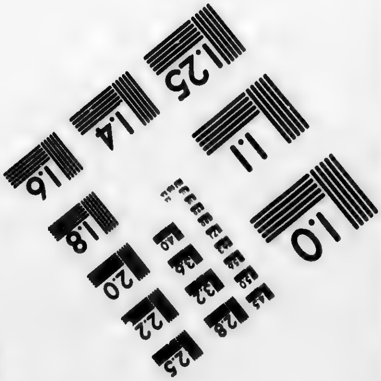

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5. If a shekel contained 240 grains, what was the weight in pounds Avoirdupois of the head of Goliath's spear, which was 600 shekels of iron, and of his coat of mail, which consisted of 5000 shekels of brass ?

6. Find the length of paper $\frac{7}{8}$ yard wide required to cover the walls of a room whose length is 27 feet 5 inches, breadth 14 feet 7 inches, and height 12 feet 10 inches.

7. A alone can do a piece of work in 11 days, and B alone can do it in 17 days. How long would they take to do it together ?

8. One person takes 61 steps of 29 inches each in a minute, and another takes 59 steps of 31 inches each; in walking a mile how much longer will one person take than the other ?

9. Prove that a decimal is divided by 10000 by removing the decimal point in the dividend four places towards the left.

10. A farmer sold $\frac{5}{8}$ of his whole amount of land, at $25 per acre, and received for it $1000. What amount of land did the farmer own ?

XXI.

1. If 4 men mow 15 acres in 5 days of 14 hours each, in how many days of 13 hours each can 7 men mow 19½ acres ? (See Hamblin Smith, "Complex Problems.")

2. Divide

$$\frac{\frac{1}{3}+\frac{1}{5}+\frac{1}{7}}{\frac{1}{2\frac{1}{3}}+\frac{1}{6\frac{1}{2}}+\frac{1}{4\frac{1}{2}}}\times\frac{12}{71} \text{ of } 7\tfrac{1}{3} \text{ by } 1+\cfrac{2}{8+\cfrac{4}{5+\cfrac{6}{7+\frac{7}{8}}}}$$

3. The following summary is taken from a sales book: April 3 and five following days, respectively, sold 250 yds. print @ 21 cts.; 1000 yds. @ 18 cts.; 500 yds. @ 19c.; 3000 yds. @ 18 cts.; 1500 yds. at 22c.; and 375 at 20 cts. Find (1) the average selling price per yd., (2) the average number of yards sold daily, and (3) the average daily cash business for the week.

4. Lead weighs 11.4 times, and platinum 21 times as much as water; find the weight of the platinum that will be equal to 112 lbs. of lead.

5. The rates of two trains travelling in the same direction being 15 and 50 miles an hour, how long before the fast train is due at a certain station must the other leave in order to reach the next station, which is 20 miles further on, five minutes before the fast train arrives?

6. Find the G. C. M. of 68590142 and 85044059.

7. Simplify

$$\frac{1.\dot{6} \text{ of } 2.75 - 3.8}{1.\dot{6} \div 2.75 \text{ of } 3.8}, \text{ and } \frac{(.119 - .085)^2}{.119^2 - .085^2}.$$

8. A plate of copper 2 ft. 9 in. wide, 8 ft. long, and $\frac{3}{4}$ of an inch thick, is rolled into a sheet $1\frac{1}{3}$ inches wide and 18 inches long. Find its thickness.

9. A tree of 140 feet in length was broken into two pieces by falling, and $\frac{8}{21}$ of the longer piece was equal to $\frac{4}{7}$ of the shorter; find the length of each piece.

10. A man commenced business with a capital of $8000; the first year he gained $40 for every $100 invested, adding his gain to his capital; the second year he gained $25 for every $100 invested, adding his gain as before; the third year he lost $\frac{1}{7}$ of his accumulated capital; how much did he make in the three years?

XXII.

1. Reduce $\frac{1}{3}$ of $7\frac{1}{2}$ of $.3\dot{6}$ of $1\frac{10}{11}$ of 8 m. 1 fur. 5 per. to inches.

2. What are the prime factors of 75675600?

3. What No. must be added to 7,869,456 to render it exactly divisible by 8975?

4. In going down street John observes that he passes a person every 6 steps he takes. Now if he step 30 in. at a time and walk at the rate of 4 miles per hour, how many persons will he pass in a walk of 15 minutes?

5. A can dig a garden in 5 days of 8 hours each, B can do it in 4 days of 12 hours. How many days of 10 hours each will it require to dig the whole garden when both work together?

6. What will be the size of the largest measure with which 2 bins which contain 39 bush. 2 pks. 3 qts. 1 pt. and 45 bush. 1 pk. 1 gal. 1 qt. 1 pt., respectively, can be emptied by an exact number of fills of the measure? Give answer in pints.

7. A farmer laid out $71778 in purchasing an equal number of sheep, hogs, and cows. Each sheep cost $6, each hog twice as much as a sheep, and each cow twice as much as a hog. How many of each did he buy?

8. A purse and its contents are worth £1 6*s.* 8*d.*, and the purse is worth 7 times the contents. What is the value of each?

9. A owns $\frac{3}{5}$ of a ship and B the remainder, and $\frac{3}{4}$ of the difference between their shares is $1500. What is the vessel worth?

10. There is a number which when multiplied by

$2\frac{1}{7}$, and the product diminished by 1400, and the result divided by $2\frac{1}{2}$, and this new result increased by 8, and the sum divided by 4, gives 42 for a quotient. Find the number.

XXIII.

1. A speculator gave $18810 for horses, and sold a certain number of them for $7990, at $85 each, losing thereby $10 each; for how much each must he sell the remainder so as to gain $2180 on the whole?

2. In 161384 inches how many miles?

3. A man bequeathes $\frac{1}{3}$ of his property to his wife, $\frac{3}{8}$ of the remainder to his son, and $\frac{7}{8}$ of what then remained to his daughter, and the balance, $1000, to establish a scholarship in a High School; find the amount each person received.

4. Simplify

$$\left\{3\tfrac{1}{2} \text{ of } 5\tfrac{1}{9} - 12\tfrac{4}{7}\right\} \times \left\{3\tfrac{7}{8} - \left(4\tfrac{1}{2} - 2\tfrac{1}{5}\right)\right\} \div \frac{1\frac{3}{7}}{\left(2\frac{1}{3} - 1\frac{1}{4}\right) \times \dfrac{1}{8\frac{4}{7}}}$$

5. A boy starts to run 800 yds., taking three steps in a second, each step three feet long; he is followed after an interval by a dog which makes two bounds of 6 ft. each in every second; find what start, both in time and distance, the boy must have so as not to be overtaken by the dog.

6. In a certain business one partner whose share is $\frac{3}{11}$ of the whole, receives from it a profit of $859.20; what share is owned by another whose profit is $1969?

7. Fifteen cubic inches of copper of specific gravity 8.7, five cubic inches of tin of specific gravity 7.4, and two cubic inches of lead of specific gravity 11.4, are

melted together; find the specific gravity of the bronze formed by the mixture.

8. Show that

$$\frac{.\dot{2}\dot{1}}{.\dot{2}1\dot{1}}=\frac{2331}{2321} \text{ and that } \frac{1}{2^2}+\frac{2}{2^3}+\frac{3}{2^4}+\frac{4}{2^5}+\frac{5}{2^6}+\frac{6}{2^7}=\cdot 9375.$$

9. Find the price of 184 tons 17 cwt. 3 qrs. 14 lb. of copper @ £87 17*s.* 11*d.* per ton. Qr.=28 lbs.

10. Of the number of candidates that presented themselves at certain entrance examination $\frac{4}{17}$ were plucked in arithmetic; $\frac{3}{13}$ of the remainder were plucked in grammar; and of those that still remained $\frac{2}{15}$ were plucked in other branches; the number of successful candidates was 26; find the entire number of candidates.

XXIV.

1. Multiply 50738 by 4620, and verify the result by dividing the product by the factors of the multiplier.

2. If 6 articles cost $14.30, how much will 13 cost at the same rate.

3. The sum of $288 is to be divided among 24 men, 36 women, and 72 children, so that the shares of two men shall be equal to that of three women, and each woman's share equal to that of two children; what will be the share of each?

4. If 68 bales of linen contain 67048 yards, and each bale contains 34 pieces, and each piece the same number of yards, how many yards are there in each piece?

5. If a merchant mark his goods on credit 20 per cent. above cash price, what ready money will he take for an article marked $26?

6. Two workmen could complete a piece of work, working separately, the one in 5 hours, and the other in 8 hours; what part of the work could they get through in 1 hour, working together?

7. Simplify $\frac{2\frac{1}{4}-1\frac{1}{3}}{2\frac{1}{5}+1\frac{1}{4}}$; and $\frac{22.4}{.25}+\frac{250}{.8}+\frac{1.2}{.0075}$.

8. A bought of B 34 yards, and of C 46 yards of cloth, at $5.50 per yard. Having sold ¼ of these purchases to D, at a profit of $1.25 per yard, at what rate must the remainder be sold that his profit may be $150 on the whole?

9. A farmer mixed fifteen bushels of oats worth 40 cents a bushel with 5 bushels of corn worth 80 cents a bushel, what is the mixture worth per bushel?

10. If 5 oxen or 7 horses eat up the grass of an enclosure in 74 days, in what time could 5 horses and 7 oxen eat up the grass of the enclosure?

XXV.

1. Reduce to simplest form

$$\frac{11\frac{2}{5}\div 2\frac{8}{9} \text{ of } 1\frac{29}{35}}{5\frac{1}{7} \text{ of } 3\frac{9}{12}\div 2\frac{4}{19}}\div\frac{1\frac{3}{25}}{1\frac{47}{49} \text{ of } 1\frac{1}{15}}.$$

✓ 2. If a sovereign weigh 123.274 grains, how many sovereigns will weigh 21 lbs. 4 oz. 16 dwt. 10 grains?

3. A, B, and C are joint owners of a ship; C's share is valued at $2000, A's share is ⅓ of B's, and the sum of their shares ⅝ of the value of the whole ship; find the value of the shares held by A and B.

4. Express as decimals $\frac{2^5}{10^8}$; and $\frac{3^4}{10^6}$; and find the difference between $\frac{\cdot 26+\cdot 2 \text{ of } 3\cdot 7}{\cdot 48-\cdot 014 \text{ of } 20}$ and $\frac{4\cdot\dot{3}+5\cdot\dot{6}}{7\cdot\dot{4}-\dot{2} \text{ of } 11}$

5. A farmer bought 48.125 tons of hay; for 20.25 tons of it he paid $16 per ton, and for the rest $18.2625 per ton; he sold the whole at the average price of $.945 per cwt.; how much did he gain or lose?

6. What will it cost to cover with lead a cistern whose depth, length and breadth are 3 ft. 6 in., 7 ft. 10 in., and 5 ft. 4 in., respectively, at $2.43 per square yard?

7. If 1¼ guilders are equivalent to 9 shillings, and 10 shillings are equivalent to 12·5 francs, find how many francs to 24 guilders.

8. The expense of carpeting a room was $45; but if the breadth had been three feet less than it was the expense would have been $36; find the breadth of the room.

9. A, B, and C met; A had 5 loaves, B had 3 loaves, and C had 40 cents; they divided the loaves fairly, and C divided the money fairly between A and B; how much did each receive.

10. A mechanic earns on an average $1.87½ a day, and works 22 days per month; if his expenses are $25.75 a month, how many years will it take him to save $1116, there being 12 months in a year?

XXVI.

1. A farmer has three tracts of land. The first and second contain 280 acres each, and the third contains twice as much as the other two; how many acres does the farmer own? And what would the whole amount to at $201 per acre?

2. A cistern whose capacity is 15000 gallons is supplied with water by two pipes, each discharging 325

gallons per hour; but, by leakage, the cistern loses, during the filling, at the rate of 100 gallons per hour. In what time would the two pipes fill the cistern?

3. An upholsterer has 125 yards of carpeting of one kind, 175 of another, and 225 of another. He wishes to divide the whole into pieces of equal length, and the longest that can be thus obtained; what must be the length of each piece?

4. One person expends $5 for coal, at $7 per ton; and another $6, at $9 per ton. Which of them obtains the greater quantity of coal?

5. Find the value of the expression

$$\left(\frac{5}{3\frac{1}{3}}+\tfrac{1}{3} \text{ of } \tfrac{2}{3} \text{ of } \tfrac{2}{5} \text{ of } 20\right) \div \frac{3\frac{1}{4}}{6\frac{1}{2}}.$$

6. Multiply 10.5 by 1.05, and reduce the result to a fraction in its lowest terms.

7. How many square feet of glass are required to glaze 5 windows, each containing 14 panes of glass, the panes measuring 17 inches by 15 inches?

8. A man buys 25 sheep for $144, and 30 more for $184; what will he gain or lose by selling them at $6.10 apiece?

9. A person who has $\frac{3}{8}$ of a mine sells $\frac{3}{4}$ of his share for $6000. What is the value of the whole mine to him?

10. A person contracts to do a piece of work in 30 days, and employs 15 men upon it; the work is half finished in 24 days; how many additional workmen must be then introduced in order to perform the contract?

XXVII.

1. Define prime numbers; numbers prime to each other; composite numbers; abstract and concrete numbers.

2. Gunpowder is composed of nitre, charcoal and sulphur, in the proportion of 15, 3 and 2; find what weight of gunpowder would correspond to 45 cwt. of nitre, and find also the corresponding weights of charcoal and sulphur.

3. Express $\frac{5}{8}$ of 17*s.* 6*d.* + .125 of 16*s* — $.5\dot{2}\dot{7}$ of 13*s.* 9*d.* as a decimal fraction of £5.

4. How many bricks 9 inches long, $4\frac{1}{2}$ inches broad and 4 inches thick, will be required for a wall 30 ft. long, 20 ft. high, and 4 ft. thick, allowing the mortar to make up one-sixteenth of the entire wall?

5. In a cricket match the highest score was $\frac{1}{6}$ of the whole number of runs, the next five scores amounted together to $\frac{4}{7}$ of the whole, the remaining five scores to $\frac{8}{35}$ of the whole, and there were seven wides; find the total score.

6. Reduce $.\dot{7}6923\dot{0}$ to a vulgar fraction in its lowest terms, and find, to eleven decimal places, by how much $3+\frac{1}{7+\frac{1}{16}}$ differs from 3.14159.

7. What number is that which increased by 2 and multiplied by 3, the product diminished by 50, and the remainder divided by 825, gives the quotient of $.120\dot{6}$?

8. Simplify

$$\frac{1}{1+\frac{1}{1+\frac{1}{5}}}+\frac{1}{1+\frac{1}{5}}, \text{ and } \left(\frac{2\frac{3}{4}}{4\frac{1}{5}}-\frac{1\frac{1}{8}}{1\frac{1}{3}}\right) \text{ of } \frac{1}{\frac{20}{63}-\frac{27}{84}}$$

9. A sum of £250 17*s.* 6*d.* is transmitted from London through Paris to New York; £1 English = $24\frac{79}{100}$ francs French, and $6\frac{1}{5}$ francs = \$2.25; find the value of the sum in American currency.

10. A piece of work can be done by A alone in 6 days, by B alone in 5 days, and by C alone in $4\frac{1}{2}$ days; they all begin it together, but A only continues to work till it is finished, B leaving off $2\frac{1}{8}$ days, and C $1\frac{1}{2}$ days before its completion; in what time is the work accomplished?

XXVIII.

1. A merchant bought 290 yards of cloth at 9 dollars per yard. Having sold 137 yards of it, at 14 dollars per yard, and 81 yards, at 15 dollars per yard; what would he make on the whole by selling the remainder at 16 dollars per yard.

2. A can build 7 rods of fencing in a day, B can build 9 rods, and C 12 rods, in a day. What quantity of fencing would afford a number of full days' work for any one of the three?

3. The working wheel of a locomotive is 226 inches in circumference. It turns 91 times in a minute; through how many furlongs, perches, &c., does it draw the train in a minute?

4. A contributed towards a charitable purpose $23\frac{1}{2}$ dollars, B contributed twice as much as A, C as much as B, D as much as A and B together, and E as much as all the rest. What was the whole contribution?

5. What is the difference in the gain per cent. between selling goods at 2*d.*, which cost $1\frac{1}{3}$*d.*, and selling goods at $2\frac{1}{3}$*d.* which cost 2*d.*?

6. How may the relative magnitudes of two or more fractions be compared? Express by the least integers the relative magnitude of the fractions $\frac{11}{16}$, $\frac{13}{28}$ and $\frac{23}{36}$.

7. Reduce to the simplest form :—

$$(2\tfrac{1}{3}+1\tfrac{1}{6}+3\tfrac{1}{2})\div\tfrac{1}{4}\text{ of }\tfrac{5}{6}\text{ of }1\tfrac{4}{5}$$

8. Find what decimal multiplied by 8750 will give the sum of 17.5, $\frac{1}{100}$ of 86, $\frac{3}{700}$ of 1801, and 96.812.

9. Find the difference between

$$\frac{4\frac{7}{10}+5.\dot{8}\dot{1}-2.5}{4\frac{7}{10}\text{ of }32\text{ of }.\dot{4}\dot{5}}\quad\text{and }\tfrac{9}{10}\text{ of }\tfrac{7}{27}\text{ of }.875.$$

10. A and B together can mow a meadow in 5 days, and B could do it himself in 8 days. In what time could A mow the meadow?

XXIX.

1. Find the cost of 13 lbs. 8 oz. 17 dwts. 11 grs. at £1 2*s*. 3*d*. per lb.

2. Two clocks point to 2 at the same instant; one loses 3½ seconds and the other gains 4 seconds in 12 hours; when will one be half an hour before the other, and what time will each clock then show?

3. Express $2\frac{1}{7}$ of $1\frac{1}{2}$ tons $-\frac{11}{20}$ of 4 tons $+2\frac{2}{3}$ of $1\frac{7}{8}$ cwt. $-\frac{4}{7}$ of 1 ton 12 cwt. as the fraction of $\frac{1}{4}$ of $10\frac{2}{7}$ of a ton $+\frac{1}{4}$ of $\frac{10}{7}$ cwt.

4. The specific gravity of atmospheric air compared with water is .0012; I ask for the specific gravity of common gas, and am told it is .45 compared with air; find its specific gravity compared with water.

5. A quantity of tea was sold for one dollar a pound, the gain being one-tenth of the cost price; the total gain was $57.60; how much tea was sold?

6. An engine, A, is pumping 10,000 gallons of water per minute from a mean depth of 200 fathoms, on a consumption of 14,400 lbs. of coal per day, while another, B, is pumping 16,000 gallons per minute from a depth of 60 fathoms, on half the quantity of coal; which is working most economically, and in what ratio?

7. Divide

$$\left(\frac{1+\frac{1}{3}}{1-\frac{1}{3}} \div \frac{1+\frac{3}{5}}{1-\frac{2}{5}}\right) \text{ by } \frac{1-\frac{12}{25}}{8\frac{1}{3}+\frac{2\frac{3}{4}}{\frac{3}{4}}} \text{ of } \left(\frac{1+\frac{2}{3}}{1-\frac{2}{3}}\right)^2 \text{ of } \frac{1+\frac{1}{5}}{1-\frac{1}{5}} + \frac{1+\frac{5}{13}}{1-\frac{5}{13}}.$$

8. Find the cost price of lead per cwt., if the sale of 48 cwt. for $218.70, give a profit of one-eighth of the original price.

9. Simplify

$$\frac{91.31+.0298}{.1-.092574}, \text{ and } 3.875\times 3.\dot{5}\div 5.\dot{6}\dot{3}\times\frac{3.05}{3.0\dot{5}}.$$

10. A and B engage in business, A contributing $12,000, and B $8,000; B is to have one-tenth of the profits for managing the business; how should a profit of $10,000 be divided?

11. An income first pays the water rates, and on the amount thus reduced an income tax of 2½ cents in the dollar, and then only $\frac{13}{20}$ of the gross income remains; find the water rate.

XXX.

1. Reduce to its lowest terms the following fractional expression:—

$$\frac{767 \text{ acres } 9 \text{ chains } 279 \text{ yds } 4 \text{ ft.}}{208 \text{ sq. miles } 181 \text{ acres } 93 \text{ yds. } 4 \text{ ft.}}$$

2. A horse-power will lift 33,000 pounds one foot high per minute; how many gallons of water per day

of 24 hours will an engine of 120 horse-power lift to the height of 140 fathoms, a gallon of water weighing 10 lbs ?

3. What must be added to .356 of £2 17*s*. 10*d*. to make up $\frac{1}{13}$ of £8 19*s*. 7½*d*. ?

4. Water expands when freezing so that a cubic foot of water becomes 1.089 ft. of ice ; find how many cubic feet of water there are in an iceberg which is 900 ft. long, 88 ft. broad, and 220 ft. high.

5. Simplify

$$\frac{\frac{3}{8} \text{ of } 8\frac{1}{4} - \left(\frac{1}{1\frac{1}{2}} \text{ of } \frac{1}{2\frac{1}{3} - 1\frac{4}{5}}\right)}{\frac{1}{2\frac{2}{3}} + \frac{1}{1\frac{6}{7}} + \frac{1}{4}} \text{ of } \frac{\frac{1}{3} + \frac{1}{5}}{\frac{1}{3} - \frac{1}{5}} \times \frac{1\frac{1}{4} - \frac{11}{15}}{\frac{1}{1\frac{1}{4}}}$$

6. If eggs are sold at the rate of 85 for 48 cents, and the gain at this rate is one-fifth of the outlay, find at what rate per dozen they were purchased.

7. Find the cost of 20 tons 16 cwt. 3 qrs. 22 lbs. of coal at 25 shillings per ton.

8. A reservoir is 56 ft. 8 in. long by 17 ft. 6 in. broad; how many cubic feet of water must be drawn off to make the surface sink 2 feet 6 inches ?

9. A parcel of 12 lbs. weight is carried 80 miles by rail for 56 cents, and the rate for the distance over 50 miles is two-thirds of the rate for the first 50 miles; how far can a parcel of 8 lbs. be carried for 16 cents?

10. Bought 100 bbls. flour @ \$5.12½, and 250 bushels wheat @ \$1.06¼; sold 75 barrels of the flour @ \$6.50, and all the wheat @ \$1.37½; find at what price per bbl. the remainder of the flour must be sold in order to gain \$221.87½ on the whole investment.

XXXI.

1. Define divisor, dividend, quotient, remainder. How many of these are abstract when the dividend is abstract? How many are concrete when the dividend is concrete?

2. Reduce to its simplest form,

$$\frac{(3\frac{3}{5}-\frac{2}{11}) \text{ of } 12\frac{4}{5}}{3\frac{2}{5}-\frac{2}{11} \text{ of } 12\frac{4}{5}} \div (12\frac{3}{5}-2\frac{2}{7}) \text{ of } \left\{7\frac{7}{8}-\frac{3}{10} \text{ of } (15\frac{3}{4}-2\frac{5}{8})\right\}$$

3. At what price per lb. must a grocer sell sugar which cost him $15.40 per cwt., so that on every $44 of outlay he may gain the cost price of 80 lbs.

4. Find the expense of papering a room 80 ft. 6 in. long, 24 ft. 8½ broad, and 11 ft. high, the paper being 2 ft. 8½ in. wide, and costing 81 cents a yard.

5. Prove the rule for changing a mixed circulating decimal to a vulgar fraction. Find a recurring decimal equal to $5.8\dot{7}\dot{4}+1.\dot{6}2\dot{1}-.2\dot{8}-1.\dot{7}4812\dot{6}+2.2\dot{4}2\dot{8}$.

6. A and B commence a piece of work on Monday morning, and by Wednesday night have done $\frac{7}{15}$ of it; A then leaves, and B completes the work in 9 days; in how many days could each working separately have done the work?

7. A man bought 2400 bushels of wheat at 90 cents a bushel, and found that, by mistake in measuring it, he had more than he paid for to the extent of 2.25 bushels in every hundred; he sold the whole quantity at $1.05 a bushel; find how much he made by the transaction.

8. The first and second terms of a proportion are .0836 and .6875 respectively, and the fourth term is $\frac{7}{8}$ of the sum of these numbers; find the third term.

9. I bought 4250 lbs. of wheat at $1.02 a bushel, and 3408½ lbs. of oats at 64 cts. a bushel; I sold the oats at a certain loss per bushel, and the wheat at an advance of 14 cts. per bushel, gaining on the whole 98 cts.; at what price per bushel did I sell the oats?

10. Make out in correct form (with the amount) the following bill of goods: Jas. Smith sold to Jno. Brown, 450 lbs. sugar @ 12½ cts., 240 lbs. do. @ 11¾, 320 lbs. rice @ 10½ cts., 220 lbs. coffee @ 22½ cts.; 30 boxes oranges @ $3.75, 16 do. lemons @ $3.37½, 15 do. raisins @ $4.12½.

XXXII.

1. Define multiplicand, multiplier, product. What kind of number is the multiplier in every instance? Find area of board 4 ft. long and 3 ft. wide, and explain clearly what kind of units the two factors respectively express. Shew why, when the multiplier is greater than 12, each successive partial product is put one place farther to the left.

2. Find the number of rails each 24 ft. long, and weighing 20 lbs. 8 oz. to the foot, that can be made out of 100 tons 8 cwt. 16 lbs. of steel.

3. Reduce to a decimal,

$$\frac{7\frac{1}{4}\times 3\frac{1}{3}}{6\frac{1}{2}\text{ of }\frac{1\frac{1}{3}}{13}} \div \frac{\frac{3}{8}\text{ of }11}{\frac{1}{7}}\text{ of }\frac{232}{2541}-\frac{1}{3}\text{ of }\frac{7}{12}\text{ of }\frac{3}{8}\text{ of }\frac{4}{11}\text{ of }8\tfrac{1}{4}.$$

4. If a model of the earth were made with a diameter of 20 feet, express as the fraction of an inch the height of the highest mountain, taking the earth's diameter as 7912 miles, and the actual height of the highest mountain as 30,000 feet.

5. If wire fencing cost 2*s.* 4*d.* per yard, find what must be paid for enclosing a field 305 yds. long and 156 yds. wide. Answer in dollars and cents.

6. A garrison of 1000 men, provisioned for 60 days, was reinforced at the end of 18 days, and the provisions were exhausted at the end of 30 days from that time; of how many men did the reinforcement consist?

7. Find how many cubic yards of water are displaced by a ship whose gross weight is 750 tons, granting that a cubic foot of water weighs 64 lbs.

8. There are four village lots: the first contains $\frac{1}{3}$ of $\frac{3}{5}$ of an acre, the second $40\frac{2}{3}$ rods, the third $\frac{1}{7}$ of an acre, and the fourth $\frac{3}{7}$ of $\frac{5}{8}$ of an acre; find the quantity of land in the four lots.

9. How much water must be added to 68 gallons of brandy, worth \$4.40 a gallon, in order that the mixture may be worth \$3.60 a gallon?

10. Find the value of $.7\dot{9}$ of 5.125 shillings $+.725$ of $13.\dot{3}$ shillings $-.125$ of two shillings $+.75$ of a penny. Answer in shillings and pence.

XXXIII.

1. Simplify

$$\frac{8\frac{3}{4}}{7\frac{1}{3}} \text{ of } \left(1\frac{1}{7} \text{ of } 2\frac{4}{5}+6\frac{7}{8}\div 2\frac{3}{4}\right)+\frac{1}{5} \text{ of } \left(5\frac{1}{2}+\frac{.24+.\dot{5}\dot{3}}{2.2-.\dot{6}\dot{4}}\right)$$

2. The amount of duties collected at the Toronto Custom House on the 26th January, 1877, was \$3421.98. Assuming that the average duty was $17\frac{1}{2}$ per cent., find the invoice value of the goods on which the above amount was paid.

3. A can do in 10 days, B in 12 days, and C in 15 days, a piece of work for which \$64 is to be paid; they all begin together, and work $3\frac{1}{2}$ days, when B and C leave, and the work is finished by A. How should the money be divided?

4. Express an English mile in terms of the French kilometre, the kilometre being 1000 metres, and 64 metres being equal to 70 yards.

5. "Authorized rate of discount on American invoices, 6 per cent."—(*Mail*, Jan. 29.) Assuming this, find (in Canadian cy.) the duty at 17½ per cent. on goods invoiced at $4380.

6. A and B have equal incomes; A's expenditure is to B's as 6:5; at the end of two years A has saved $600, which is $\frac{6}{11}$ of B's savings; what is the income of each?

7. Find the cost of an embankment a mile long, 4 ft. high, and 18½ ft. wide, at 12 cents per cubic yard for the first foot in height, and 2 cents a yard extra for each successive foot in height.

8. If a new unit of weight were instituted containing 1 lb. 1 oz. 3.326 drs. avoirdupois, how many such units of weight would make 537 lbs. 11 oz. 15 drs.?

9. A railway train travels 30 miles an hour, including stoppages, and 35 miles an hour when it does not stop; in what distance will the train lose 2 hours by stoppages?

10. Of the candidates at an entrance examination, .07 failed in grammar, $\frac{12}{31}$ of the remainder in arithmetic, and 57 passed; find the number of candidates.

XXXIV.

1. Add together 5 rods, 7 fathoms, 8 cubits, 5 English ells, 8 chains and 8 inches; express the result in feet.

2. Take the G. C. M. of 448, 728, 822, and 952, from the L. C. M. of 2½, 5, 12½, 17½ and 35, and divide

the difference diminished by $23\frac{1}{2}$ by the sum of 324 and 76.

3. Reduce $\frac{13}{19}$, $\frac{18}{19}$, $\frac{26}{19}$, $\frac{37}{19}$, $\frac{4\frac{1}{2}}{9\frac{1}{2}}$ and $\frac{6\frac{1}{2}}{4\frac{3}{4}}$ to equivalent fractions having the same *numerator*.

4. A can do as much work in one hour as B can do in one hour and a half, and B can do twice as much work in the same time as C. If A, B, and C can do a piece of work in 6 days, in what time would each of them do it?

5. Find the sum of $\frac{\text{5 guineas}}{£7} + \frac{\text{4 yds.}}{\text{5 French Ells}} + \frac{\text{1 oz. Avoir.}}{\text{1 scruple.}} + \frac{\text{1 dr. Avoir.}}{\text{1 dwt.}} + \frac{1077}{2304} + \frac{451}{1920}$.

6. Multiply $\left(\frac{2}{3} + 4\frac{3}{5} - \frac{3\frac{1}{2}}{\frac{3}{4}\text{ of }7} - \frac{3 + \frac{3}{4 + \frac{1}{2}}}{5 + \frac{3}{3 + \frac{1}{7\frac{1}{2}}}}\right.$ by $\frac{8\frac{3}{4} + \frac{4}{5}}{7\frac{1}{3} - 5\frac{2}{3}}$.

7. If 6 ac. 3 r. 18 per. 4 yds. of land cost $200; find the price at the same rate of a square piece of land one furlong in length.

8. A traveller sets out from Toronto to Brampton, and travels uniformly at the rate of 3 miles an hour, and returns at the rate of 4 miles an hour: he was an hour and a half longer in going than returning: find the distance from Toronto to Brampton.

9. Reduce to its simplest form, $\frac{\cdot 3 + \cdot 07}{111 \times \cdot 01} + \frac{\cdot\dot{3} + \cdot 2\dot{9}}{\text{[illegible]}} - \frac{\cdot\dot{3}\dot{7}}{\frac{37}{33}} + \frac{\text{£4 17s. 6d.}}{\text{£1}\cdot 04\dot{9}} + \frac{4\cdot 368 \text{ miles}}{\text{1 mile, 13 per. 1 ft.}} + \frac{11}{30} + \frac{\text{4 tons 13 cwt.}}{5\cdot 875 \text{ lbs.}}$.

10. If 48 pioneers in 5 days of $12\frac{1}{2}$ hours long, can dig a trench 139·75 yds. long, 4·5 yds. wide, and 2·5 yds. deep, how many hours per day must 90 pioneers work during 42 days in order to dig a trench 1636.6875 yds. long, 4·875 yds. wide, and 3·2 yds. deep?

XXXV.

1. Simplify

$$\frac{8\frac{2}{3} - \frac{1}{3} \text{ of } \frac{1}{2}}{6\frac{3}{4} \times \frac{1}{3} \text{ of } \frac{1}{2}} + \frac{10\frac{3}{4} \div \frac{1}{4} \text{ of } \frac{1}{2}}{21\frac{1}{2} \div \frac{1}{4} \times \frac{1}{2}} + \frac{2.\dot{6}}{\frac{2}{7}} - \frac{\cdot\dot{3}}{.1\dot{6}}.$$

2. Reduce $2\frac{1}{2}$ of $3\frac{1}{3}$ of $\frac{1}{5}$ of $3\frac{1}{4}$ English ells to the fraction of $\frac{2}{3}$ of $\frac{5}{6}$ of $5\frac{3}{5}$ French ells.

3. A can do a piece of work in 5, B in 6, and C in 8 days. If A and B work at it two days each, how long will it take B and C to finish it?

4. A man buys land at \$60 per acre. If he sell $\frac{1}{4}$ of it to A at \$80 per acre, $\frac{1}{5}$ of the remainder to B at \$22 for $\frac{1}{4}$ of an acre, and the rest, which is 120 acres, to C at \$75 for $\frac{3}{5}$ of an acre; what is his gain or loss?

5. Sold tea at 90 cents per lb., having gained $\frac{3}{20}$ of the cost, find the selling price per lb., if he had lost $\frac{3}{20}$.

6. A man can row a boat from A to B (a distance of 30 miles) in $7\frac{1}{2}$ hours if there be no current; how long would it take him to row it if there was a current of $1\frac{1}{2}$ miles per hour from B to A?

7. If A can do $\frac{3}{5}$ of a piece of work in $2\frac{1}{4}$ days, and B can do $\frac{4}{5}$ of the same work in $3\frac{3}{4}$ days, how long will it take A and B working together to do it ?

8. Divide $2380 between A and B so that $\frac{2}{3}$ of A's share will be equal to $\frac{3}{4}$ of B's.

9. A man divided his property as follows:—He gives to his eldest son $\frac{1}{3}$ of his property, to his second son $\frac{1}{3}$ of the remainder, and to his wife what was then left. If he had given his second son twice as much he would have received $800 more than the eldest. Find the share of each.

10. Bought 180 gals. wine @ $2.60 per gal.; paid for carriage $8.60; for duties $5.80. If $\frac{3}{20}$ of it be lost by leakage, at what price per gal. must the balance be sold to gain by the whole transaction $10.60 ?

11. A can do a piece of work in 4, B in 5, C in 6 days. If A and B work at it $1\frac{1}{2}$ days each, how much will it be worth to finish it if A and C can earn $2.80 per day ?

XXXVI.

1. Distinguish between abstract and concrete numbers; in multiplication show that the multiplier cannot be concrete.

Simplify $\dfrac{186 + 7980 \times 7080 \div 7847 - (491 - 305)}{225 \times 160 \div 5 \times 8.}$.

2. If 3 turkeys and 5 geese cost $4.75, and 2 turkeys and 7 geese cost $3.50, what is the price of 10 turkeys ?

3. Define reduction ascending.

With the difference between £1 17*s.* 9*d.*, Halifax currency, and 3.68\frac{1}{3}$, I purchase an equal number of oranges, figs, and apples; the oranges costing *5d.*, the figs 2*d*., and the apples 1*d*. each; how many of each did I purchase?

4. What is the difference in length between 5 perches 2½ yds. and 17 English ells, 3 qrs. 3 nls.? (Answer in inches.)

5. What is the distinction between the simple and compound rules?

A farm containing 486 acres 2 ro. 14 per. 12 yds. 2 ft. 72 in. was divided among A, B and C, so that B received 79 acres 1 ro. 39 per. 23 yds. 3 ft. 103 inches more than C, and 41 acres 12 per. 12 yds. 2 ft. 36 in. less than A; how many inches in A's share?

6. By what must 141 miles 1 fur. 1 per. 3½ yds. 1 ft. be divided so as to give 5 for quotient and leave 3 m. 5 fur. 33 per. 2 yds. for remainder?

7. Define a fraction. How is fraction reduced to its lowest terms? Give the reason for the process.

Reduce the difference in weight between 2 lbs. of lead and 2 lbs. of silver to the fraction of 6 drs. 2 scrs.

8. An estate worth $10,000 is left to A, B and C; ⅜ to A, ⅖ to B, and the remainder to C; find C's portion and its value.

9. If $\frac{1.\dot{3}}{2}+2\frac{1}{3}\div4\frac{1}{5}+\frac{3}{4}\times1.2\div.3$ of an acre of farm land cost $\frac{2\frac{1}{3}+\frac{1}{2}\div\frac{1}{5}}{(2\frac{1}{3}+\frac{1}{2})\div\frac{1}{5}}$ of \$850, what ought a village lot to cost which is 132 feet long by 330 feet wide, if land in the village be worth 2⅓ times as much as farm land?

10. A does ⅔ of a piece of work in 4 hours, B does ¾ of what remains in 1 hour, and C finishes it in 20 minutes; how long would it have taken all working together to do the work?

XXXVII.

1. When an ounce of gold costs $19.45, what is the the cost of .04 lb.?

2. An imperial gallon contains 277.274 cubic inches. How many gallons would a vessel contain whose capacity is 98¼ cubic feet?

3. Required the mean of the following observations of temperature:—41° 29′, 41° 27½′, 39° 18′, 41° 38′, 37° 47½′, 44° 28′, 40° 18′.

4. Feb. 5, 1877: "Gold in New York opened at 105¼." At this rate, how much gold must be paid for 4210.42\frac{1}{10}$ currency?

5. There was a question whether the indemnity to be paid by the King of Ashantee was 5,000 oz. of gold or 50,000 oz.; what was the amount of money in dispute, gold being reckoned at £3 17*s.* 10½d. per oz.?

6. A man instructed his servant to lay out equal sums in buying oxen, sheep and horses, and to spend as little as possible. The servant agreed to forfeit $2 for every ox, $1 for every sheep, and $4 for every horse which he bought more than was necessary to obey orders. He bought the oxen at $40 each, the sheep at $5 each, and the horses being at the prices of $50 each and $60 each, he bought those at $50 each. What should be the forfeit on account of the mistake?

7. A, B and C run a race. A starts at 9 a.m., and goes at the rate of 8 miles an hour; B starts at 10.15 a.m., and goes at the rate of 10 miles an hour; when should C start, who goes at the rate of 12 miles an hour, so that when A is overtaken by B, C may be one mile behind them?

8. If 2 cwt. 3 qrs. 21 lb. sugar cost $58.40, find the value of 17 cwt. 2 qrs. 14 lb. (Cwt.=112 lbs.

9. A block of stone is 4 ft. long, 2 ft. 6 in. broad, and 1 ft. 3 in. thick; it weighs 27 cwt.; find the weight of 50 cubic inches of the stone.

10. A candidate at an Entrance examination obtained as an answer to a question 27 ft. 8 inches; but found that he had used 5.4 instead of 5.2 as a multiplier; find the *correct* answer.

XXXVIII.

1. The dividend decreased by 13 is equal to 33 times the remainder; the difference between the remainder and divisor is 9; the quotient is 21; find the divisor, dividend, and remainder.

2. Prove that $\frac{5}{8}$ of 1 = $\frac{1}{8}$ of 5. Simplify

$$\frac{\left(\frac{4\frac{1}{4}}{17}+\frac{17}{4\frac{1}{4}}\right)\times\left(\frac{17}{4\frac{1}{4}}-\frac{4\frac{1}{4}}{17}\right)\times 9999\frac{7773}{7777}}{(3\frac{17}{28}+\cdot\dot{1}4285\dot{7})\times 2125.}$$

3. A has four times as much money as B; they play together, each staking 10 shillings; A wins the first game, but loses the next ten games, and then three times A's money is equal to seven times B's: what had each at first?

4. In a school there are 153 scholars in the lower form, and 119 in the upper form. The scholars are so divided that the number in each class in the lower form and upper form is the same, and the number of classes as *few* as possible. Find the number in each class and the total number of classes.

5. Suppose unity to represent ·0012, what number represents ·0001?

6. A man buys 100 gallons of wine at $2.00 a gallon, and keeps part for his own use. In selling at $2.25 a gallon, by using a false measure he gives $3\frac{24}{25}$ quarts for a gallon, clearing $25.00 by the sale. How many gallons did he keep for his own use?

7. A company of boys is met by A, who gives each boy 40 cents; afterwards the boys are joined by 16 others, and the money received from A divided equally among all the boys, who are met by B, and he gives each boy 30 cents; afterwards the boys are joined by 18 others, and the money is again equally divided, when it is found that each boy has 20 cents. How many boys in the company when met by A?

8. A grocer buys tea at 64 cents a lb. and sells it so as to gain $\frac{6\frac{1}{2}}{32}$ of the cost price; find his receipts on 6048 lbs.

9. A man divides the value of his estate equally among his three sons. The first son gains an amount equal to one-third of what he has; the second loses one-third of what he has, and the third gains one-third of what he has, and then loses one-third of what he has after his gain; and now the sons together have $300 less than the value of the estate. What was its value?

10. I sold $20,000 stock of Consolidated Bank at 98½ and invested the proceeds in Bank of Commerce stock, selling at 120, and paying a half-yearly dividend of $4½ on every $100 of stock; find my half-yearly income.

XXXIX.

1. What number divided by 36821 will give a quotient 5627 with remainder 824?

2. In multiplying a number by 39, I begin the partial product of 3 and the multiplicand under the figure in the tens' place of the product by 9. Why do I do so? Show that the sum of the partial products is the complete product.

3. Addition, Subtraction, Multiplication and Division are called the fundamental rules of Arithmetic; why are they so named?

4. In making out a bill for 65 bushels of oats at 40 cents per bushel, I multiply 65 by 40, and give the result $26.00. Am I correct? Give reasons for your answer.

5. The less of two numbers is $\frac{54\frac{3}{8}}{\frac{1}{5} \text{ of } 8\frac{2}{3}}$, and their difference is $\frac{1\frac{4}{5}}{\frac{9}{16}}$; what is the greater number?

6. How much must be paid for 360 feet of boards at $12.00 per M, 250 shingles at $2.50 per M, and 760 feet of timber at $1.00 per C?

7. A and B set out at the same time from places 88 miles apart, and meet at the end of 12 hours; A travels 1¾ miles per hour more than B. How many miles did each travel?

8. Sold a house for $4800, and gained ¼ of its cost. What did it cost?

9. If 10 men can do a piece of work in 12 days, how soon after beginning must they be joined by 3 more so as to finish the work in 10 days?

10. If a man fill ⅓ of a cask with brandy, ¼ with wine, and ⅕ with water, and it lack 21⅔ gallons of being full, how many gallons will that cask contain?

XL.

1. In 1234567 sq. in., how many acres, roods, &c.?

2. The remainder 8 is $\frac{2}{3}$ of the divisor, and $\frac{4}{13}$ of the quotient; find the divisor.

3. If I purchased $2\frac{5}{8}$ yds. of black cloth at 16*s.* 6*d.* per yard, $2\frac{3}{8}$ yds. doeskin at 7*s.* 6*d.* per yard, $3\frac{1}{2}$ yds. alpaca at 1*s.* 6*d.* per yard, $1\frac{3}{4}$ yds. linen at 1s. 8d. per yard, and $5\frac{1}{2}$ yds. flannel at 1*s.* 10*d.* per yard. What change should I receive out of a twenty-five dollar bill?

4. Add $\frac{5}{8}$ of a peck to $2\frac{3}{4}$ gals., and reduce the result to a decimal of 4 bus. 2 gals. 2 qts.

5. Reduce to its simplest form,

$$\frac{5\frac{5}{8} \text{ of } \frac{3}{25} + 3{\cdot}\dot{3} \text{ of } 2 - 1\frac{1}{3}}{\frac{1}{17}(2{\cdot}0\dot{4}\dot{5} - {\cdot}5).}$$

6. The bottom of a cistern measures 7 ft. 6 in. by 3 ft. 2 in., how deep must it be to contain 76 cubic ft. of water?

7. A boy gives $\frac{1}{2}$ of his marbles to A, $\frac{1}{3}$ to B, and the rest to C. C loses 20, and has then 70 less than A. How many had each at first?

8. A man lost $\frac{2}{5}$ of the value of his horse by selling it for \$60; for what should he have sold it to gain $\frac{3}{5}$ of its value?

9. A man has \$4000 in the bank. He drew out $\frac{3}{20}$ of it, and then $\frac{1}{5}$ of the remainder, and afterwards deposited $\frac{1}{3}$ of what he had drawn out. How much had he then in the Bank?

10. A man after paying a tax of 2 cents on every dollar of his income, and also spending \$2 per day, is still able to save \$495 a year (365 days); what is his income?

CHAPTER IV.

EXAMINATION PAPERS

FOR

CANDIDATES FOR THIRD-CLASS CERTIFICATES.

I.

July, 1871.

1. Write in figures and express in words the numbers seven hundred and one units in the 6th period, fourteen in the 5th, one hundred and twenty in the 3rd, fouteen in the 2nd, and nine in the 1st.

2. Shew that the corresponding operation in the simple and the compound rules, are based on the same principles. How many years, months, days, hours and minutes from 20 minutes past 4 o'clock P. M., July 15th, 1862, to 25 minutes past 11 o'clock, June 29th, 1871?

3. State the principles on which is based the rule for finding the G. C. M. of two numbers. Apply them to find that of 3621 and 1581.

4. The driving wheels of a locomotive are $17\frac{1}{2}$ feet in circumference, and the trucks $10\frac{5}{8}$, what distance must the train move to bring wheel and truck into same relative positions as at starting?

5. State the general principles on which the rules

of fractions depend; and find the simplest form of $(7\frac{3}{4} \div 5\frac{1}{4})$ of $\{ (4\frac{1}{2} \times \frac{7}{8}) + 1\frac{3}{5} \} \times (3\frac{1}{2} - \frac{9}{10})$.

6. From the sum of $2\frac{19}{24}$ acres, $\frac{2}{3}$ of $3\frac{1}{3}$ acres, $\frac{9\frac{1}{2}}{25\frac{1}{3}}$ roods, and $\frac{3}{11}$ of $1\frac{1}{11}$ perches, take 4 acres, 25 perches, 12 square yards.

7. A man divided a farm among three sons; to the first he gave 80 acres, to the second $\frac{4}{9}$ of the whole, and to the third $\frac{3}{4}$ as much as to both the others. How many acres did the farm contain?

8. Find the sum, difference and product of $3{\cdot}45\dot{6}$ and $\cdot 42\dot{5}$.

9. Find values of 2·7345 according as the unit is £2 5*s*., or 5 acres, 2 roods, 10 perches, or 6 oz. 10 dwt., 16 grs.

10. Sold 20900 feet of lumber for \$331·62½, gaining thereby \$78·37½. What had it cost per C?

11. Explain the difference between simple and compound proportion. In Nova Scotia the Sovereign is worth \$5, and in Ontario \$4·86⅔; convert, \$2720·40 Ontario currency into Nova Scotia currency.

12. (*a*) Received \$4100 from my agent, who had deducted his commission at 5 %, as proceeds of sale of goods; what were the goods sold at?

(*b*) Remitted \$4100, including commission, to my agent to invest for me on commission of 5 %: what was his commission?

II.

December, 1871.

1. (1). Divide £4,762 15*s*. 9¾*d*. by 300.

(2.) My house and lot cost £661 15*s*. 9*d*.; the house cost $15\frac{1}{2}$ times as much as the lot; find the cost of the house.

2. Shew clearly that both terms of a fraction can be multiplied by the same number, without changing the value of the fraction.

3. Simplify $\left((1\frac{3}{8}+\frac{5}{4} \text{ of } \frac{21}{11\frac{2}{5}}-\frac{\frac{5}{6}}{2\frac{1}{2}}\right) \div 2\frac{77}{114}$.

4. A sum of money was divided among A, B, and C; A received $\cdot\dot{9}3\dot{9}$ of $\frac{15}{31}$ of it; B, $\frac{3}{11}$ of it, and C, $3015.80; find the amount divided.

5. A trench 80 yards long, 10 feet deep and 9 feet wide, was completed by 20 men in $12\frac{1}{2}$ days, of ten hours each; and a trench 76 yards long, and twelve feet deep was completed by thirty men in $7\frac{1}{2}$ days, of $9\frac{1}{2}$ hours each; how wide was the latter trench?

6. The cost of carpeting a room $10\frac{1}{2}$ yards long, with carpet 27 inches wide, and costing $1.35 a yard, was $93.15: find the width of the room

7. A grocer mixes 60 lbs. of tea at 65 cents a lb., with 80 lbs. at 60 cents a lb.; at what rate per lb. must he sell the mixture to gain 80%?

8. A person loaned $480 for two months and 18 days at 9%: what interest did he receive?

9. I send $5250 to a commission merchant in Montreal, who charges 5% for investing, with instructions to purchase certain goods, deducting his commission from the amount of money sent him: find his commission.

10. A coal dealer bought 784,000 lbs. of coal, at $4.50 a ton (2240 lbs.), and sold 524,500 lbs. of it at the rate of $5.50 per short ton (2000 lbs.), and the balance at $4.20 per short ton: find the whole gain.

III.

July, 1872.

1. The demand of 10 hours' pay for nine hours work is equivalent to a demand of what increase % in wages ?

2. What number divided by $(\frac{2}{19}+\frac{1}{13})\div(3-\frac{1}{5})\times(\frac{1}{3}+\frac{1}{5})$ will give $\frac{3}{14}$ of $\frac{4\frac{5}{9}}{6\frac{1}{6}}$ of $\frac{6\frac{8}{11}}{11\frac{5}{7}}$ of 247 ?

3. Find amount of following account:—448 lbs. butter at 23 cents, 436 lbs. cheese at $9\frac{1}{4}$ cents, $240\frac{3}{4}$ lbs. lard at $11\frac{2}{3}$ cents, $254\frac{7}{8}$ lbs. tallow at $13\frac{1}{2}$ cents, $40\frac{1}{2}$ dozen eggs at $16\frac{2}{3}$ cents, 15 bbls. salt at $1·40, and $481\frac{11}{16}$ lbs. ham at $12\frac{1}{2}$ cents.

4. A bankrupt owes four creditors as follows:—A $2500, B $3300, C 4200, and D $4000; his property is worth $10500; what does each creditor receive ?

5. A lumber merchant bought 106250 feet of lumber at $14\frac{3}{8}$ per M., and retailed it at $1·75 per C. Find his gain.

6. Find the expense of plastering a room 20 feet long, $18\frac{1}{4}$ feet wide, and $11\frac{1}{3}$ feet high, at 18 cents a yard.

7. If 25 men build a wall 15 ft. high, 2 ft. thick, and 50 ft. long, in 12 days of 9 hours each, how many hours per day must 40 men work to build a wall 60 feet long, 3 feet thick, and 20 ft. high in 25 days ?

8. How much water must be mixed with 600 gallons wine, at $2·50 a gallon, in order to make the mixture worth $2 per gallon ?

9. If $120 gain $5·84 in 126 days, find the gain in 360 days.

10. A merchant bought 500 bls. of flour at $6·25 a bl., on a credit of 8 months. He sold it at $6·50 a bl. on a credit of 4 months. What was his net cash gain, money being worth 12% ?

IV.

July, 1873.

1. Define a fraction and fully explain the terms numerator and denominator.

Simplify $\dfrac{\frac{5}{9} \text{ of } \frac{3}{7}}{6\frac{1}{5} - 5\frac{4}{15}} \div \dfrac{\frac{2}{3} \times 1\frac{1}{12}}{\frac{1}{13} \times 5\frac{1}{2}}$. $\dfrac{25}{196}$

2. Bought $\frac{2}{5}$ of $4\frac{1}{3}$ cords of wood for $\frac{2}{5}$ of $\frac{2}{3}$ of $30: what were two cords worth at the same rate ?

3. Show how to convert pure circulating decimals and mixed circulating decimals to vulgar fractions.

Find the sum of $\cdot\dot{4}7\dot{8}$, $\cdot\dot{3}2\dot{1}$, $\cdot 3\dot{2}$, $\cdot\dot{7}856\dot{4}$, $\cdot\dot{5}$, and $\cdot\dot{4}32\dot{6}$, and the product of $3\cdot 45\dot{6}$ by $\cdot 42\dot{5}$.

4. How many feet of lumber will be required to inclose a building $60\frac{1}{2}$ feet long, $40\frac{1}{4}$ feet wide, 22 feet high, and each side of the roof $24\frac{1}{6}$ feet, allowing $523\frac{1}{4}$ feet for the gables, and making no deductions for doors and windows ?

5. Find the difference between the true and the bank discount of $2500, payable in 90 days, at 7 per cent.

6. Find cost of plastering the walls of a room $30\frac{1}{2}$ feet long, $18\frac{1}{2}$ feet wide, 12 feet high, at 18 cents per square yard (no allowance for openings); find also the cost of carpeting such a room with carpet 27 inches wide, and costing $1.80 per yard.

7. Ten per cent. of an army was slain on the field of battle, and 5 per cent. of the remainder were mortally wounded: the difference between the killed and

mortally wounded was 1100; how many men went into battle?

8. Having received a stock dividend of 8 per cent., I find I am now the owner of 297 shares; how many shares did I own at first?

9. Given, that pure water is composed of oxygen and hydrogen in the proportion, by weight of 15 to 2, find the weight of each in a cubic foot of water.

10. How many railway shares (100 each) at 40% discount must be sold in order that the proceeds invested in bank stock, which is 4% below par, and pays a dividend of 7%, may yield an income of $1680.

11. A railway company pays $24.75 per acre for a portion of road 100 miles long and $94\frac{1}{2}$ feet wide, find the whole amount paid.

12. An insurance company took a risk at $2\frac{1}{4}$%, and reinsured $\frac{3}{5}$ of the risk at 2%; the premium received exceeded the premium paid by $42; find the amount of the risk.

V.

DECEMBER, 1873.

1. From a pound Troy are coined $46\frac{29}{40}$ sovereigns; find (in £ s. d.) the price per oz. of gold.

2. Divide $29.50 between two persons, so that one shall receive half as much again as the other.

3. Simplify $\frac{1}{5}$ of $\frac{13}{16} - \frac{1\frac{2}{3}}{13\frac{1}{3}}$ of $\frac{19}{20} + \frac{3}{14}$ of $\frac{6\frac{5}{12}}{3\frac{2}{3}}$. $\frac{67}{160}$

4. The sum paid for 494 gallons oil, *including* a duty on each gallon which amounts to $\frac{1}{5}$ of the cost price of a gallon, is $1719.12; find the duty on a gallon.

5. A merchant tailor bought 27 pieces of cloth, each

containing $19\frac{1}{3}$ yards, at \$4.31$\frac{1}{4}$ a yard, and paid freight \$9.62$\frac{1}{2}$; he sold so as to gain \$381.87$\frac{1}{2}$. At what price per yard was the cloth sold?

6. A and B can do a work in 3 days, B and C in 6 days, and A and C in 4 days. If \$16 be paid for the work, what is each man worth per day?

7. Find the value of 30 cwt. 1 qr. 15 lbs. of sugar at \$10.20 per cwt. (qr. = 25 lbs.)

8. A person, after paying an income tax of 2 mills on the dollar, has \$1531.93 left. Find his gross income.

9. Find the cost of covering a room 27 feet wide and 30 feet long, with matting 2 ft. 6 in. wide and costing \$1.62$\frac{1}{2}$ a yard.

10. A miller has a bin 8 ft. long, $4\frac{1}{3}$ ft. wide, and $2\frac{1}{2}$ ft. deep, holding 75 bushels; how deep must he make another bin, which is to be 18 ft. long and $3\frac{5}{8}$ ft. wide, so that its capacity may be 450 bushels.

11. A man, engaged in business with a capital of \$10920, is making $12\frac{1}{2}$ per cent. per annum on his capital; but, on account of ill-health, he quits the business, and loans his money at $7\frac{3}{4}$%. How much does he lose by the change in 2 years, $5\frac{1}{3}$ months?

VI.

JULY, 1874.

1. Simplify

$$3\tfrac{1}{2} \times \frac{\frac{1}{4}\text{ of }\frac{5}{9} \times 7\frac{1}{5}}{\frac{1}{3} + 4\frac{1}{2}\text{ of }\frac{4}{27}} + \left\{ 7\tfrac{1}{2}\;\frac{\left(\frac{2}{5} - 1\frac{1}{6} + \frac{3\frac{3}{4}}{7\frac{1}{2}} + \frac{4}{15}\right)}{\frac{7}{95} + 150\frac{5}{19} - 74\frac{2}{5}} \times 425. = 0 \right\} \qquad 3\tfrac{1}{2}$$

2. Water is composed of two gases, oxygen and hydrogen, in the proportion of 88.9 to 11.1; what weight is there of each in a cubic yard of water? (cubic foot of water weighs 1000 oz.)

3. The sum of $1,416 is to be divided among 15 men, 20 women, and 30 children in such a manner that a man and a child shall together receive as much as two women, and all the women shall together receive $480; find the amount received by each man, woman, and child, respectively.

4. A bankrupt who is paying 37½ cents in the dollar, divides among his creditors $6,300; what do his debts amount to?

5. It costs $96.25 to carpet a room 22 ft. 6 in. long, with carpet 27 in. wide and $1.75 a yard; find the width of the room.

6. If 3 men or 5 boys can do a piece of work in 17 days; in how many days will 5 men and 3 boys do a piece of work three times as great.

7. Find the cost of 38 yds. 2 qrs. 3 nails of cloth when 3.75 yds. cost $3.825.

8. A man invests half his fortune in land, a fifth of it in Bank Stock, a sixth in provincial debentures, and loses the remainder ($8,000) in speculation—What was his fortune at first.

9. Bought 9,000 bushels of wheat at $1.12½ a bush., payable in 6 months; I sold it immediately for $1,06 a bushel, cash, and put the money at interest at 10 per cent. At the end of the six months I paid for the wheat; did I gain or lose by the transaction, and how much?

3½

10. In an examination, Arithmetic and Grammar are valued at 200 marks each; Education, Geography and History, at 150 marks each. A candidate obtains 70 % in Arithmetic, 65 % in Grammar, 60 % in Education, 50 % in History, and 40 % in Geography, find his average rate per cent. (i. e. rate per cent. obtained of the aggregate marks.)

VII.

July, 1875.

1. Simplify, $\frac{16432}{22149}$

$$\left\{\frac{\frac{2}{3}+\frac{5}{8}+\frac{7}{8}+1\frac{1}{12}}{\frac{3}{4}-\frac{5}{8}}\times\frac{1}{84\frac{1}{2}}\right\}\div\left\{\frac{7\frac{1}{2}}{6\frac{1}{2}}+\frac{11\frac{1}{2}-2\frac{2}{5}}{11\frac{1}{2}+2\frac{2}{5}}\times 10\frac{9}{13}-7\frac{1}{5}\right\}$$

2. A wine merchant pays $175 for a hogshead of wine, and bottles it off into an equal number of quart, pint and half-pint bottles: how many dozen of each has he, and at what must he sell it per dozen to gain $\frac{3}{20}$ of his outlay?

3. What must be the face of a note so that when discounted at a bank for 4 months and 9 days, at 9 per cent., it will give $240?

4. A, B and C having equal shares of a ship, sell respectively one-third, one-quarter, and one-fifth of their shares to D, who dies and leaves his share equally among them: If B's and C's interest in the ship be now worth $37,300, what is the value of A's share?

5. A farmer has 500 bushels of wheat; he can sell it at once for $1.20 a bushel; by storing it for six months at a cost of $20 paid in advance, he can realize $1.30 a bushel; he adopts the former course; money being worth 8% per annum, determine how much he has gained or lost by so doing.

6. Express the value of $\cdot 8\dot{3}$ of 8s. + $\cdot\dot{0}\dot{5}$ of 2 guineas + 1.8 of 5s.

7. A merchant bought a number of barrels of flour for $1800; he used 20 bbls. and sold $\frac{4}{5}$ of the remainder for $1568, which was $224 more than cost. How many barrels did he buy?

8. When gold is quoted at 133⅓, what is the gold value of a $10 greenback?

9. A piece of land whose length is 151 yds. $1\frac{1}{4}$ ft., and breadth 85 yds., is to be exchanged for part of a strip of land of the same quality, whose breadth is 15 yds. $2\frac{1}{2}$ ft. Find the length of the equivalent strip.

10. What is the duty on 4 hogsheads of sugar each weighing 1280 lbs., gross, at $2\frac{3}{4}$ cents a pound; tare 14 per cent.

11. A merchant in New York wishes to remit to London a bill of exchange for £298 1*s.* 0*d.*; what is the cost of this bill when exchange is at $9\frac{1}{2}$% premium?

VIII.

N. S., JUNE, 1875.

1. Find the value of $\dfrac{5\frac{1}{2}\left(\frac{3}{4}-\frac{1}{4}\right)}{11\div\left(\frac{3}{10}-\frac{1}{2}\times\frac{1}{5}\right)}$ of 4 shillings, and express $\dfrac{2^7}{7\times10^7}+\dfrac{2^3}{3\times10^3}$ in decimals.

2. A. and B. agree to divide their travelling expenses in the proportion of $1\frac{2}{5}$ to 1. A. pays on the whole \$129, and B. \$75.26; what has the one to pay and the other to receive in order to settle the account?

3. A certain number of men, twice as many women, and three times as many boys earn \$124 in 5 days; each man earned \$1.20, each women $66\frac{2}{3}$ cents, and each boy $53\frac{1}{3}$ cents per day. How many were there of each?

4. Seven-tenths of the selling price of certain goods is two per cent. less than cost. Find the gain per cent. at which the goods are sold.

5. At $2\frac{1}{2}$ per cent., what will be the cost of insuring property worth \$3600, so that in the event of loss the

worth of the goods and the premium of insurance may be recovered?

6. A, B, and C, do a work in 10 days; A does $1\frac{1}{4}$ times what B does in the same time, and B does $\frac{3}{4}$ what C does in the same time. How long would it take each to do the work?

7. Bought a number of cattle for $2000; had I bought 20 head more at a cost of ten dollars per head less, my entire outlay would have been $2800. How many cattle were purchased?

8. Find interest on a note for $515.62, dated March 1st, 1873, and paid July 16th, 1875, at 8%.

9. A man mowing grass walks at the rate of ·35 miles an hour, and in 70 minutes mows a grass plot of 1056 square yards; how broad does he mow?

10. A tradesman has a cash price for goods and a nine months' credit price: money being worth 8% per annum simple interest, find the ratio of the prices.

IX.

July, 1876.

1. Find what quantity must be added to

$$\left(\frac{1\frac{1}{2} \text{ of } 3\frac{1}{3}}{3\frac{1}{2} \text{ of } 2\frac{2}{3}} \text{ of } \frac{1\frac{3}{7} \text{ of } 1\frac{1}{6}}{\frac{1\frac{2}{7} \text{ of } 32\frac{2}{3}}{3\frac{1}{2}}} + \frac{2\frac{1}{8} \text{ of } 6\frac{2}{3}}{3\frac{1}{6} \text{ of } 4\frac{1}{2}}\right)$$

to make it equal to $\left(\frac{1}{23\frac{2}{7}} \text{ of } 3\frac{3}{4} \text{ of } 3\frac{1}{7} \text{ of } 1\frac{2}{7} \times \frac{5}{6}\right)$

2. Reduce to its simplest form

$\frac{(\cdot075)^3 + (\cdot025)^3}{(\cdot075)^2 - (\cdot075)\,(\cdot025) + (\cdot025)^2}$; and divide $9\cdot\dot{1}704\dot{5}$ by $3\cdot\overset{\prime}{3}\overset{\prime}{6}$, giving the result to the end of the first period.

3. Express $\frac{3}{40}$ of 12*s*. 6*d*. + $\frac{4}{15}$ of 8 guineas + $\frac{2}{19}$ of £4 − $\frac{3}{70}$ of $2\frac{1}{3}$*d*., as a fraction of £5.

4. A merchant marks his goods so that he may allow a discount of 5% and still make a profit of 15%. Find the marked price of broadcloth that cost him $3.80 a yard. $4.60

5. At an election in a constituency in which the number of voters was 1,800, the votes polled by the candidates were in the ratio of 7 to 5, and the successful candidate was elected by a majority of 240. Find the number who did not vote. 360

6. A rectangular plot of ground is 60 feet long and 50 ft. wide; one pathway is made surrounding the plot on the outside, and two others intersecting at right angles in the middle of the plot; if these pathways are 5 feet wide and cost $62\frac{1}{2}$ cents a square yard, find their entire cost. $119.79+

7. A and B engaged in business, the former contributing $7,500, the latter $4,500. The gross receipts for the first year were $2,800, of which 5% was paid for insurance, and $14\frac{2}{7}$% for other expenses; of the balance, B received a certain sum for managing the business, and the remainder was divided in proportion to the capital invested: A's share was $1,250; find B's allowance as manager. $260

8. At what rate per cent. will $1,520 amount to $1,733.75 in $2\frac{1}{4}$ years? Find also in what time $33.40 will double itself at $6\frac{2}{3}$ per cent. per annum. 15 yrs 6¼%

9. A drover bought 400 sheep at a certain price per head. He sold $\frac{3}{5}$ of them at a gain of 20%, $\frac{3}{10}$ of them at a gain of 15, and the remainder at a loss of 10%, gaining on the whole $217. How much did he pay for the 400 sheep? $2480

10. If 8 horses are worth 7 cows, and 5 cows cost as much as 30 sheep, and 16 sheep cost $165; find the value of 12 horses. $1732 $\frac{1}{2}$

X.

1. Simplify $\frac{1}{3}$ of $\frac{\frac{1}{3}-\frac{1}{4}}{\frac{1}{5}-\frac{1}{11}}+\frac{1}{3}$ of $\frac{\frac{1}{2} \text{ of } \frac{3}{4}-\frac{5}{8} \text{ of } \frac{2}{3}}{\frac{1}{8} \text{ of } 1\frac{5}{11}-\frac{2}{11} \text{ of } 16\frac{1}{2}}$. $\frac{77}{279}$

2. If 8 men can do as much in a day as 4 boys; how long will it take 64 boys to finish a piece of work of which 12 men have done a quarter in 16 days? 12 days

3. A horizontal engine was erected at a cost $3765.48; find its value at the end of two years, allowing for depreciation at $5\frac{1}{2}$ per cent. per annum, and for wear and tear at $3\frac{1}{4}$ per cent. per annum.

4. If £3 = 20 thalers, 25 thalers = 93 francs, 27 francs = 5 scudi, and 62 scudi = 135 gulden; how many gulden = £52 12*s*. 6*d*.? 526.25

5. A train 160 yards long ~~is approaching~~ met another 150 yards long; the first is going at the rate of 40 miles an hour, and the second at the rate of 18 miles. Find how long a person in the long train will see the other while passing it. 5 $\frac{185}{638}$ sec

6. A vessel worth $12336 is lost, on which the owner had paid a premium of $3\frac{1}{2}$ per cent; what had he insured for if he recovered all moneys paid, in addition to the value of the vessel? $12783.419+

7. A banker lent to the same merchant $2304 on the 23rd of March, $1680 on the 16th of June, and $1728 on the 29th of September; the merchant repays the whole sum, with interest, on the 2nd of January. Find the amount repaid, interest being $7\frac{1}{2}$ per cent. per annum. $5949.69 $\frac{63}{73}$

8. The true discount on $1235.68½ for 210 days is $31.18½; find the rate per cent. 4½ %

9. What sum of money must be divided among A, B, and C, so that A may have $1.44, and C $2.25, and that B may have as much per cent. more than A as C has more than B? $5.49

77
2.79

10. Divide the number 474 into three such parts that three times the first may be equal to 5 times the second and to eight times the third. 240, 144, 90

ys

XI.

1. Reduce to its simplest form

$$\frac{(\cdot05)^3-(\cdot025)^3}{(\cdot05)^2+(\cdot05)\,(\cdot025)+(\cdot025)^2}.$$ .025

2. "Sterling exchange in New York is quoted at $4.86 for demand bills, and $4.86½ for 60-day bills." A merchant in New York owes another in London £1500, which he can either pay at once or in 60 days with interest at $6\frac{1}{12}$ per cent. per annum (365 days); find whether it will be more profitable for him to discharge the debt by a *demand* bill or a 60-day bill, and how much he will save by the more profitable course. He gains saves $80.47½ by taking demand bill

3. If 60,000 bricks are required for a wall 50 yards long, 15 ft. high, and 1 ft. 10½ in. thick; and if each brick be 9 in. long and 4½ wide, find its thickness. 3 in

4. A grocer sold, at 51 cents per lb, a portion of a stock of tea, incurring a loss of 15 per cent., and a total loss of $18 on the quantity sold; he then increased the selling price so as to gain 20 per cent., and having sold the balance of his stock at the increased rate found that he had gained $78 on the sale of the entire stock. Find the quantity of tea at first. 1000 lbs

5. \$500. Toronto, Feb. 1st, 1876.

For value received I promise to pay Thwaite, Eby & Co., or order, five hundred dollars, three months after date, with interest at six per cent. per annum; endorsed as follows: May 1, 1876, \$40; Nov. 14, 1876, \$8; April 1, 1877, \$12; May 1, 1877, \$30. How much was due when the note was finally paid Sept. 16, 1877? \$453.57

6. If 13 were added to a certain number, $\frac{5}{8}$ of $\frac{4}{9}$ of the sum would be 40; find the number. 131

7. A person investing in railway stock paying 4% receives 5 per cent. for his money; find the price of the stock. 80

8. The average of 21 results is 61, that of the first 8 being 64, and of the next eleven results 59. Find the average of the last two. 60

9. The French kilometre contains 1000 metres, and 64 metres are equal to 70 yards; how many yards are there in a kilometre? 1093¾ yds

10. Coals are 20 per cent. cheaper this year than last; if the price were to rise \$1 a ton, they would still be fifty cents a ton cheaper than last year; find the price last year. \$7.50

XII.

A 504
B 252
C 168

1. A, B, and C can do a work in 84 days, A, B, and D in 72 days, A, C, and D in 63 days, B, C, and D in 56 days; how long would it take each alone to do it? D 126

2. A gallon measure contains fragments of a mixed metal, and these are found to weigh 56 lbs.; 2½ pints of water are then poured into the measure and exactly fill it; find the specific gravity of the metal, a gallon of water weighing 10 lbs. 8.145+

3. A publican uses measures which are false to the extent of 5%; but his brewer gave him in every barrel only 35 gallons. The publican buys at \$5.04 a barrel and sells at 4 cents a pint. What does he gain on a sale of 200 barrels? \$1349.89 $\frac{9}{19}$

\$455.57

4. Bought a quantity of goods for \$227.92 payable 12 months hence, and sold them at once for \$275.56 payable 9 months hence. Find the cash gain, allowing discount at $4\frac{1}{2}$ per cent. \$48.45+

5. A grocer had 150 lbs. of tea of which he sold 30 lbs. at \$1.08 per lb., and found he was gaining only $7\frac{1}{2}$ per cent.; at what price must he sell the remainder in order to gain 10% on his whole outlay? \$1.11 $\frac{6}{43}$

6. The price of pure gold is £4 2*s.* 6*d.* an oz.; the price of a mixture of gold and silver weighing 18 lbs. is £694 13*s.*, but if the weights of silver and gold in the mixture were interchanged, the value would be £255 15*s.* Find the weight and value of the silver in the mixture.
£14 " 0s " 6d — 5 7 oz

7. How long will it take to walk along the four sides of a square field containing 16ac. 401 sq. yds., at the rate of 3 miles per hour? 12 $\frac{15}{22}$ min

8. What is the least sum of money for which I could purchase a number of cows at $\$20\frac{2}{9}$ each, a number of oxen at $\$47\frac{2}{3}$, or a number of horses at $\$51\frac{1}{3}$, and what number of each class, respectively, could I purchase for that sum? \$667 1/3; 33 cows, 14 oxen, 13 horses

D 126

9. If an oz. troy of standard silver of which 37 parts in 40 are fine, be worth \$1.23, and copper be worth \$25.20 per cwt., what is the ratio of the value of fine silver to that of copper? $\frac{25625}{333}$ when val. of alloy is neglected

10. Three partners A, B, and C gain \$17100; A's gain and C's are together \$11000, and $\frac{2}{5}$ of A's is equal to $\frac{8}{35}$ of C's. Find each man's gain.

A's \$4000, B's \$6100 & C's \$7000

XIII.

1. Two equal kegs are filled with mixtures of spirits and water in the ratio of 1 to 3, and 1 to 4, and the contents are then poured into a single keg. Find the strength of the mixture. Water : spirits :: 31 : 9

2. I sold a quantity of Bank of Commerce stock at 115, and invested in Consolidated Bank stock at 92, which I afterwards sold at 98, and re-purchasing my Bank of Commerce stock which had risen to 120, I found I had gained $125 by the operations. How much Bank of Commerce stock had I?

3. A boy hires with a farmer for $100 a year and a suit of clothes, but leaving at the end of 7 months, receives $50 and the suit of clothes. Find the value of the clothes. $20

4. Two sums of money are to be divided among three persons, one sum equally and the other in the proportion of 3, 5, and 8; the shares of the first two amount to $64.56 and $81.36; determine the sums. $118.08 & $134.40

5. If the rates of wages of a man, a woman, and a child, be as 6, 3, and 1; and 25 men, 30 women, and 16 children get $640 for 10 day's work; find how much 32 men, 36 women, and 72 children should get for 8 days' work. $744

6. The end of the minute hand of a clock moves $1\frac{2}{17}$ inches every ten seconds; in how many revolutions will it move 20 miles? $3149\frac{9}{19}$

7. A man has a triangular field of which the sides are $115\frac{1}{2}$ feet, $128\frac{1}{3}$ feet, and $134\frac{3}{4}$ feet; find the length of the longest boards of equal length that can be used in fencing it without cutting a board. 6 5/12 ft

8. A barters some tea with B for flour which is worth

55 cents a stone, but uses a false pound weight of $15\frac{4}{7}$ oz., what must B charge for his flour that the exchange may be fair? 56 cents a stone

9. A man finds that his half-yearly income will be $\$3\frac{1}{2}$ more by investing in Dominion Bank stock at 125 and paying $4\frac{1}{2}$ % half-yearly, than by investing in Bank of Commerce stock at 120 and paying $4\frac{1}{4}$ % half-yearly. How much has he to invest? $6000

10. Gold is sold at the mint at £3 17*s.* 9*d.* per oz., and is mixed, with alloy worth 5*s.* 2*d.* per oz., in the ratio of 11 to 1; if Sovereigns are coined of this mixture each weighing 5 dwts. 3.247 grains, find approximately what is the Mint profit on 100 Sovereigns.

XIV.

84$134.40

1. Find value of

$$\frac{5\frac{1}{2}+6\frac{3}{4}}{6\frac{3}{4}-5\frac{1}{2}}+\frac{1}{2}\left(\frac{5}{6}+3\frac{1}{2}-1\frac{1}{4}\right)-\left(7\frac{5}{8}-6\frac{2}{3}\right)$$
$$-9\frac{23}{60}$$

2. Divide ·0564 by 14·1 and give reasons for the position of the decimal point.

3. What vulgar fractions are reducible to finite decimals?

Reduce to its simplest form

$$\frac{\frac{2}{3}}{\frac{4}{5}}\times\frac{\dfrac{1}{7\frac{2}{3}}}{\dfrac{1}{\cdot0\frac{8}{9}}}\times\frac{\dfrac{\cdot00\frac{2}{3}}{7}}{\dfrac{\cdot003\frac{1}{3}}{25}}\times\frac{207}{500}.$$

4. A man bought a store and contents for $4720; he sold the same for $12\frac{1}{2}$ % less than he gave, and then lost 15 % of the selling price in bad debts. Find his entire loss. $1209½

5. Paid three sums of money in succession, each

of which took ⅓ of the money I had before paying it less 50 cents, after which I had \$33$\frac{1}{18}$ remaining. How much had I at first? $108

6. Sold wheat at \$1.00 per bushel and gained \$30 on the quantity sold; had I sold it at \$1.12½ I would have gained \$42 on the same quantity. How many bushels did I sell? 96 bushels

7. Seven men engage to do a piece of work in a certain time, but three of them failing to come, the work was prolonged 7½ days. In what time would the seven men have done it? 10 days

8. A merchant sells 90 lbs. of tea and coffee for \$76, the tea at 90 cents. and the coffee at 40 cents. per lb.? How many lbs. of each did he sell? 80 lbs tea; 10 lbs coffe

9. A grocer in selling goods sells 15¾ oz. for a pound, how much does he cheat a customer who buys to the amount of \$40? \$.62½

10. Sold goods for \$2.10 and gained ⅓ of the price. What part of the cost would be gained by selling at \$2.60? 6/7

XV.

(2) ·06576728+

1. Find a decimal multiplier which will convert Troy ounces per inch into tons per mile; use this multiplier (2) to find the weight in tons per mile of wire which weighs $\frac{3}{100}$ of an ounce Troy to one inch in length. (1) 2·1722$\dot{4}$2857$\dot{1}$

2. If the value of one pound of gold is 14 times that of a pound of silver, and the weight of equal bulks of gold and silver are in the ratio of 19 to 10; find the value of a bar of silver equal in bulk to £1750 worth of gold. £ 65" 15s" 9$\frac{9}{19}$ d.

3. Find the true and the mercantile worth on a note

(1) £216"14s"6 $\frac{1345\cdot5}{1475\cdot3}$ d

for £219 drawn on the 4th of June at 4 months, and discounted on the 14th of July, discount being allowed at 4½ per cent. (Reckon days of grace.) (2) £216"14s"1⅕d

4. When the 3 per cents were at 90, I found that by selling out and investing in Indian 4 per cents at 95, I could improve my income by £24 6*s*. Find the amount of my stock in the 3 per cents. £3078

5. A owns $\frac{3}{8}$ of a vessel and B the remainder; the vessel is sold, A receiving 60 per cent. of his share of the money, and B 20 per cent of his; B afterwards received $4000 from the purchaser, and the balance then due was divided equally between A and B. What is the ship sold for? $50000

6. A man sells out $\frac{3}{8}$ of stock in a certain railway, paying 2 % half-yearly dividends, at four and invests in Bank of Commerce stock at 120 and paying 4 % half-yearly dividends; he finds that his income is thus increased $33⅓; find the amount of his railway stock. $4166 2/3

7. A man's income is derived from the proceeds of $4550 at a certain rate per cent, and $5420 at one per cent. more than the former rate; his whole income being $453, find the rates 4 % and 5 %

8. A mixture of black and green tea weighing 12 lbs. is worth $8.70; if the proportions of each are interchanged, the mixture will be worth $6.90; the black tea is worth 80 cents per lb.; find the price of the green tea. $.50

9. A, B, and C can together do a piece of work in 20 days; after 6 days A gives up and is succeeded by D who does half as much again as A, B, or C can do in a day. When will the work be finished? 12 days

10. If I get in London £1 for 25 francs 20 centimes, what shall I gain or lose per cent. by taking French money into Bavaria, where the exchange is 11 gulden 40 kreutzers for £1, and 8 gulden 20 kreutzers for a Napoleon? (1 gulden = 60 kreutzers, Napoleon = 15*s.* 8*d.*)

XVI.

1. Find the difference between

$$\frac{\cdot 004 \div \cdot 0005}{2\cdot 4\dot{2}\dot{3} + 3\cdot\dot{5}7\dot{6} + 2\cdot 0\dot{0}01911\dot{1}} \text{ of } £2, \text{ and } \frac{3\frac{1}{4}}{7\frac{1}{3} \text{ of } \frac{3}{4}} \times \frac{\frac{5}{7} - \frac{1}{4}}{\frac{3}{8} + \frac{3}{7}} \text{ of } £9.$$

2. A, B, and C are employed to do a piece of work for $26.45; A and B together are supposed to do $\frac{3}{4}$ of it; A and C $\frac{9}{10}$ of it, and B and C $\frac{13}{20}$ of it, and are paid on this supposition. Find each man's share. A $11.50 B 5.75 C. 9.20

3. In a certain constituency the total number of votes is 2500: 20% of these refuse to vote at an election at which A, B and C are candidates; 5 per cent. of those who vote spoil their ballots, and of the number of votes counted by the returning officer, 20 per cent. of A's equals 25 per cent. of B's, and 10 per cent. of B's equals 4 per cent. of C's. Find the number of votes for each. A 500; B 400; C 1000

4. A farmer gave for a horse a bill of $272, due in two months, and sold him at once for a bill of $316, due in 5 months; find the former's gain or loss, true discount being reckoned at 4½ per cent. $40.20 gain
No days of grace "

5. In a certain factory were employed men, women, and boys; the boys received 3 cents per hour, the women 4, and the men 6; the boys worked 8 hours a day, the women 9, and the men 12; the boys received $5 as often as the women $10, and the women $10 as

often as the men $24. How many men, women, and boys, respectively, were there, the whole number being 59? 24 men, 20 women, 15 boys

6. A crew can row down stream a distance of 4 miles in 30 minutes, and up stream the same distance in 34$\frac{2}{7}$ minutes. Find the rate of the stream. $\frac{1}{2}$ ml per hr

7. A grocer increased the price of sugar, charging for 7 lbs. what he before sold 8 lbs. for; he made 25 per cent. profit at his former price; find the profit after the rise in price. 42 6/7 %

8. At what rate must a note payable 18 months hence, without days of grace, be discounted to produce 7% interest? 6 $\frac{74}{221}$ %

9. The area of one of the faces of a cubical block is 660.49 sq. ft.; find the volume. 16974.593 cub. ft.

10. I sold 250 yards of cloth for $345, receiving $1.30 a yard for part of it, and $1.50 a yard for the remainder. How many yards did I sell at each rate?
100 yds at $1.50
150 yds at $1.30

XVII.

1. Simplify $\{(2\cdot\dot{5}+1\cdot\dot{1}\dot{2}+\cdot\dot{3}\dot{2})\times(7\cdot2\dot{4}57\dot{4}-2\cdot\dot{6}3\dot{4})\}\div55\cdot\dot{3}$.

2. A man having $128 spends a part of it and afterwards gets 3$\frac{1}{2}$ times as much as he spent. He then has $353. How much did he spend at first? $50

3. A and B go into business with equal sums of money. A gains a sum equal to $\frac{3}{7}$ of what he had at first, and B loses $60. A then has 1$\frac{4}{7}$ times as much as B. What sums had they at first? $660

4. A fruiterer bought equal quantities of apples of two different kinds. For the first sort he pays 3 pence for 5; for the second 5 pence for 7. He sells them at

Old Canadian Currency £1 - $4

11 for 7½ pence. How many would he need to sell at this rate to gain 19 cents? 462 apples

5. The side of a field is 19⅕ rods in length, and the end 16 8/15 rods. What is the longest board that can be used in fencing both side and end of the field, so that no fraction (of a board) may be left? 8/15 rod or 8 4/5 ft

× 6. A boat can sail with the current from A to B in 40 minutes, and back in 50. Compare the rate of the current, with the rate of the boat while going down. 1:10

7. A boy can split a cord of wood in one hour, and a man can do it in half an hour. After the boy has been working for half an hour he is joined by the man. How long will they take, both working together, to finish the cord? 10 min

8. The distance between the post office and schoolhouse is half a mile. A carriage stands on the pavement in front of the schoolhouse. The fore wheels are 10 4/15 feet in circumference, the hind wheels 15 5/9 feet. A chalk mark is made upon the upper side of each wheel. How often will the 4 chalk marks be all up together while the carriage drives to the post office? 5 times

9. A and B sit down to play. A has 5½ times as much money as B. At the first game B wins ⅘ of A's money. What fraction of B's money must A win back so that they may have equal shares? $\frac{43}{108}$

10. A merchant agrees to take cordwood from a farmer, and pay for it in tea. When the wood is delivered he finds that the farmer, by using a false measure, has given 7¾ feet to the cord instead of 8. How much must he raise the price of the tea so that he may be even with him? 3 7/31 %

XVIII.

1. Sterling exchange is quoted in New York at \$4.86½ for demand bills; at this rate, how much will a New York merchant have to pay for a sight bill for £225 12*s.* 6*d.*? \$1097.66 $\frac{9}{16}$

2. A pipe whose section is 4½ square inches, delivers water into a reservoir with a velocity of 11 ft. per second: in what time will it cover half an acre 19 inches deep? 1 day " 3 hrs " 52 min

3. Multiply $\frac{3}{7}$ of ·175 by $\cdot\dot{2}8571\dot{4}$, and divide the result by ·00425.

4. Two partners, A and B, gained \$700 in trade. A's money was 3 months in trade, and his gain was \$300 less than his stock; B's money, which was \$250 more than A's, was in trade 5 months. Find A's stock.

5. Reduce $\frac{\frac{1}{6} \text{ of } 1\frac{1}{5} - \frac{1}{5} \text{ of } \frac{2}{3}}{\frac{1}{2} - \frac{2}{3} + \frac{4}{9} - \frac{1}{18}} \div \frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{8}$ of a rod to the fraction of 2 furlongs. $\frac{1}{120}$

6. A grocer, by selling 10 lbs. of tea for a certain sum, gained 20 per cent.; afterwards he increased his price, giving only 9 lbs. for the same money. How much per cent. did he make at his increased price?

7. Find the expense of papering a room 21 ft. long, 15 wide, and 12 high, with paper 30 inches wide at 18 cents a yard, allowance being made for a door 7 ft. by 3 ft., and two windows each 5 ft. by 3 ft.

8. Bought a quantity of goods for \$750 cash, and sold them on 9 months' credit for \$1000. Find the gain on the transaction, allowing true discount at 4½ per cent. per annum.

9. Supposing that a cubic inch of gold weighs 20 oz., and an equal bulk of silver weighs 12 oz., and a lump composed of gold and silver weighs 32 oz. less than if it were all gold, but 56 oz. more than if it were all silver; what is the actual weight of the lump?

10. If the second-class railway fare for 70 miles be \$2.10, what must a first-class passenger pay for travelling 126 miles, if the first-class fare for 3 miles be the same as the second-class fare for 5 miles?

XIX.

1. Simplify

$$\left(\frac{15}{6}+\frac{\frac{3}{4}+\frac{1}{2}}{3\frac{1}{3}}+\frac{4\cdot3\times2\cdot7}{21\cdot5\times13\frac{1}{2}\div\cdot25}\right)\times\left(3\cdot\dot{4}\times\frac{9}{62}\div\cdot\dot{9}\right);$$ and multiply

$$\frac{5}{7}+\frac{\frac{3}{4}\text{ of a mile}}{145\text{ yds.}}+\frac{146\text{ oz. Avoir.}}{146\text{ dwt. Troy}}+\frac{27\text{ ac.}}{134\text{ sq. chains}}$$ by $(\frac{3}{4}s. \div \cdot75d. - 12)$.

2. If A and B in 7 days make 19 chairs, and A and C in 5 days make 13 chairs, B and C in 9 days make 26 chairs; how many chairs could A, B, and C, make in 630 days?

3. If a decimal system were adopted in which £3 15*s*. 9¾*d*. would be represented by 3·47, express the unit of money in shillings.

4. Find the G. C. M. of £4 13*s*. 8*d*., £7 16*s*. 4*d*., and £1 13*s*. 8*d*., and express the answer decimally in shillings.

5. If 63 inches be equal to 16 decimetres, a litre equal to a cubic decimetre, a gallon equal 277¼ cubic inches; find the number of litres in 20 bushels.

6. What sum must be insured on a house worth \$665, so that in case of loss the owner may receive 4/7 of this snm, and also 5/6 of the premium, which was at 6 per cent.?

7. A lad undertook to go from the school house to his home by jumps, and it was found that each jump $\frac{1}{12}$ of an inch less than the preceding; his first jump was $1\frac{1}{2}$ yards, and he ceased to advance just half way between his home and the school house. Find the distance from his home to the school house.

8. A and B were employed to cut 4 acres of grass, for which $24 was to be paid; the men were to be paid in proportion to their ability to work, which was as 3 to 4, and also to the time each was engaged in the work, which was 2 to 3. Find what each received.

9. An article was bought on 8 months' credit for $203.50, and four months afterwards it was sold for 260.20\frac{3}{5}$. Assuming money to be worth 7% per annum, find the gain per cent. on the article.

10. Assuming that the earth's orbit is a circle, and that the earth is 95,000,000 miles from the sun, and that the circumference of a circle is $3\frac{1}{7}$ times its diameter; how many days would there be in a year if the earth, in each of its revolutions, advanced in its orbit the length of its circumference, which is assumed to be 25,000 miles?

XX.

1. Reduce to its simplest form $\frac{1}{2526} - \frac{1}{4344} + \frac{1}{76201}$, and find the product of $\dfrac{\frac{1}{2\frac{1}{3}} + \frac{1}{4\frac{1}{4}} + \frac{1}{6\frac{1}{6}}}{\frac{1}{3\frac{1}{3}} + \frac{1}{4\frac{1}{4}} + \frac{1}{5\frac{1}{5}}}$ by $\dfrac{\frac{1}{3} + \frac{1}{5} + \frac{1}{7}}{\frac{1}{2\frac{1}{3}} + \frac{1}{3\frac{1}{5}} + \frac{1}{4\frac{1}{2}}}$ $\times \frac{13}{71}$ of $7\frac{1}{3}$.

2. The old wine gallon is 231 cubic inches; the cubic inch is ·000016386 cubic metres, and the imperial

gallon is 4.54102 litres. How many imperial gallons are there in 157 wine gallons?

3. A has twice as much money as B; they play together for a certain stake, and the first game B wins ⅓ of A's money. What fraction of the sum B now has must A win back in the second game that they may have exactly equal sums?

4. A merchant deducts from his prices at 6 months 6 per cent. for cash and 4 per cent for 3 months' credit; find what profit he makes at his 6 months prices, if he sells, on 3 months credit, an article whose cash price is $4.70, at an advance of 95$\frac{5}{13}$ cents on cash.

5. In what time will £3699, 9 florins, 9 cents, 9 mills, amount to ten times itself at 5 per cent., and at what rate per cent. will 99*l.* 19*s.* 9¾*d.* amount to 20 times itself in 20 years?

6. The whole time occupied by a train 176 yards long, going at the rate of 20 miles an hour, in crossing a bridge is 25 seconds. Find the length of the bridge.

7. A bill is due in 2½ months, and interest is reckoned at 4 per cent.; what fractions of the principal are the interest and the true discount? Find the price of Union Bank stock if $1800 stock can be paid for with a bill for $1258.40 due as above.

8. A room whose height is 10 ft., and length 1⅓ times its breadth, takes 140 yards of paper 2 ft. wide to cover its 4 walls. What will it cost to carpet the floor with carpet 27 inches wide and costing $1.50 a yard?

9. By the sale of goods which cost me $19 I lost a sum equal to 5$\frac{5}{9}$ per cent. of the proceeds; and by the sale of another quantity which cost $24 I gained a sum equal to 31$\frac{3}{7}$ per cent. of the proceeds; what did I gain per cent. on the whole?

10. I want an alloy consisting of 19 parts by weight of nickel, 17 lead, and 41 tin; the only nickel I can obtain is 10 lbs. of an alloy containing 11 parts of nickel to 7 parts of tin and 5 of lead. How much lead and tin must I add to make up the alloy I want?

XXI.

1. What fractions is

$$\left\{\left(\frac{2\frac{3}{4}+3\frac{2}{5}}{4\frac{1}{5}+5\frac{1}{4}}+\frac{8\frac{2}{3}}{10\frac{1}{2}}\right)\times\left(\frac{2\frac{4}{11}}{2\frac{2}{5}}+\frac{2\frac{7}{11}}{8\frac{7}{10}}\right)-\frac{\cdot 281}{1\cdot 405}\right\}\text{ of }\left(\frac{4}{5}+\frac{5}{1\frac{1}{3}}\text{ of }2\frac{1}{5}-\frac{6}{7}\right)+1\frac{208}{245}?$$

2. Sterling exchange is quoted at $9\frac{1}{8}$ for sight bills; what must be paid for a draft for £42 7*s.* 6*d.*?

3. A person taking two tickets, a first and a second class, from Toronto to Napanee, pays one dollar more for the first than the second; what did they cost each if a first-class ticket from Napanee to Belleville cost 81 cents, and a second class cost 63 cents?

4. Divide $7,777.77 among A, B, C, and D, giving A $77.77 more than 40% of what B and D receive, B $88.88 less than 60% of what C and D receive, and C $99.99 more than $33\frac{1}{3}$% of what D receives.

5. A person walks to a town at the rate of $3\frac{3}{4}$ miles per hour, and, after resting half an hour, rides back at the rates of $7\frac{1}{2}$ miles an hour; he finds that he has been absent 4 hours and 10 minutes. Find the length of his journey.

6. If the true discount at 5 per cent. on a note for $249, be $9, for what length of time is the note discounted?

7. The sum of $177 is to be divided among 15 men,

20 women, and 80 children, in such a manner that a man and a child shall receive as much as two women, and all the women shall receive $60. Find how much each man, womnn, and child will, respectively, receive.

8. A sovereign weighs $123\frac{171}{623}$ grains; find the least number of pounds of gold that will coin an exact number of sovereigns.

9. Bought $64 worth of apples at 80 cents a bushel, part of which being damaged and rendered worthless, I sold the remainder at an advance of 50%, receiving $76.80. How many bushels were damaged?

10. The expense of carpeting a room 20 feet long was $66.66⅔; but if the breadth had been 3 ft less than it was the expense would have been $53.33⅓. Find the breadth of the room.

XXII.

1. 40 % of a mixture of wine and water is wine; but when 10 gals. of water are added the wine is only 35 % of the whole. How many gallons in the mixture at first? 70 gal

2. A man bought 1200 bushels of wheat for $1500; some at $1.50 and the remainder at another price; but had he bought the second lot at $1.50, and the first lot at the price at which he bought the second, he would have paid $240 more. What was the cost of the second lot per bushel? $1.20

$500
$750
$625

3. By selling a lot of land for $600, thereby gaining 20 %; a second for $600, losing 20 %; and a third at an advance of 20 % on cost; I find I have made $75 on the whole transaction. Find the cost of each lot.

4. Divide $7,200 among A, B, C, D, giving A $900

A $2700 — B $1500 — C $1800 — D. $1200

more than 40 % of B, C, D, and B $600 dollars less than 70 % of C and D, and C $400 more than 40 % of a sum which is greater than D's by $2,300.

5. A merchant supported himself 3 years for $500 a year; at the end of each year he added to that part of his stock not expended a sum equal to $\frac{1}{3}$ of this part. At the end of three years his stock was doubled. What was his original stock?

6. A and B leave London for Toronto at the same time that C leaves Toronto for London. If A goes 8 miles each hour, B 12 miles, and C 9 miles, when will C be equally distant between A and B, if the distance between London and Toronto is 114 miles? 6 hrs

7. I bought an article for $\frac{2}{3}$ of what I would have sold it for had I received $2 more for it than I did; but had I realized the $2 more I would have gained 17.33\frac{1}{3}$. Find buying and selling prices. $50, $34 2/3

8. If $\frac{2}{3}$ of A's money equals $\frac{3}{4}$ of B's, and $\frac{1}{3}$ of B's money equals $\frac{2}{5}$ of C's, and the simple interest on all their money for 4 yrs. 8 mos. at 6 % is $497. How much money had each?

9. *(a)* Can $\sqrt{2}$, $\sqrt{3}$, and $\sqrt{10}$, be sides of a triangle?

(b) The perimeters of a circle, a square, and a rectangle (which is not a square), are each a. The area of the circle is A, of the square B, of rectangle C. Show that $A > B > C$.

10. If A owes me $100 due at the end of 3 months, and $100 due in 9 months, and I accept his note for $200 at 6 months, do I gain or lose by the operation? Explain. Lose

CHAPTER V.

SECOND CLASS

AND

INTERMEDIATE EXAMINATION.

I.

July, 1871.

1. Explain fully how to state and solve a question in simple proportion. A grocer sells $14\frac{7}{16}$ oz. for a lb., how much does he cheat a customer who buys to the amount of $73·92?

2. Give exumples of the difference between Simple and Compound Practice. Convert £296 16*s*. $10\frac{3}{4}$*d*. sterling into Canada currency, the £ being worth $\$4·86\frac{2}{3}$.

3. What vulgar fractions will produce finite decimals, and why? Reduce to a decimal $\frac{\frac{2}{5}-\frac{1}{20}}{\frac{2}{5}} \times \frac{(8\frac{4}{7})^2}{12} +$ $\{(1+\frac{1}{10}) \div (\frac{3}{2}+\frac{1}{14}\} + \frac{22\frac{3}{16}}{17\frac{3}{4}}$

4. A and B can do a work in 7 days, B and C in 8 days, and A and C in 9 days; in what time will (1) each separately, (2) working all together, do the work?

5. Explain fully the terms Numerator and Denominator. Prove that both terms of a fraction can be multiplied or divided by the same number without changing the value of the fraction. Examine whether

the common definition of multiplication holds in the case of fractions.

6. Examine the different cases of profit and loss. A merchant asked 30 % advance on cost of goods, but finally took 30 % less than the price asked; how much did he gain or lose % ?

7. Show how to find the present worth of a debt payable at a future time without interest. I have 2500 bls. of flour for sale and am offered \$6·30 cash, or \$6·55 on eight months. How much shall I gain by accepting the better offer, money being worth 8½ % ?

8. Define insurance, policy, premium. A person insured a house for ⅘ its value at 1¼ % annually; after paying 6 premiums the house was destroyed, the entire loss being \$1945. Find value of the house.

9. The police returns for a certain year give 1350 male offenders, and 1150 females; the next year's returns show a decrease of 5·4 % in the number of male criminals, and an increase of 8·4 % in number of female. Find increase or decrease % in whole number of criminals.

10. A board is 3 feet wide and six feet long, find its area; show clearly that your multiplier is not concrete. Find cost of carpeting a room 22 feet 6 inches long by 17 feet 9 inches wide; the carpet being 27 inches wide and \$1·60 a yard.

11. The sides of a right angled triangle are 30 feet and 40 feet respectively, find the perpendicular from the right angle upon the hypothenuse.

12. It is required to lay out 70 acres, 3 roods, 26¾ perches of land in the form of a rectangle whose length shall be three times the breadth. Find the dimensions.

II.

December, 1871.

1. Prove the rules for converting pure recurring Decimals and mixed do. into Vulgar Fractions.

2. Simplify $\left\{\frac{2\frac{1}{2}}{16} + \frac{3\frac{1}{2}}{12} \text{ of } 3\frac{1}{4} - \left(\frac{7}{18} \text{ of } 1\frac{16}{21} - \frac{1}{6}\right)\right\} \div \left(\frac{1\frac{1}{4}}{14}\right.$ $\left. - \frac{3}{7} \text{ of } \frac{1}{8}\right)$.

3. A dealer received an invoice of glassware, 15% of which was broken; at what % above cost must the remainder be sold to clear 20% on the invoice?

4. Give the Rule for Equation of Payments; what is assumed in this Rule? A person owed $3000, payable in 10 months; he paid $800 in 4 months, and $1000 at the end of 9 months; when was the balance due?

5. A and B agree to do a certain piece of work for $25; A could do it in 8 days, and B in 10; but C joining them, the work is done in 3 days: how should the money be divided?

6. State the difference between "True" and "Bank" discount. I owe a man $575, and gave him a note at 60 days: what must be the face of the note to pay him the exact debt, when discounted at (Bank discount) 1½% a month?

7. A drover bought oxen at $40, cows at $30, and sheep at $10 a head; there were 2½ times as many cows as oxen, and 5 times as many sheep as cows, and the whole cost was $1440; how many of each kind did he buy?

8. Find the cost of painting a room 20 ft. 8 in. by 18 ft. 6 in., and 10 feet high, having two windows, each 7 ft. by 4 ft., at the rate of 50 cents a square yard.

9. An importer pays for freight and duty 10% on cost price, and sells to the retailer at a profit of 20%; the retailer sells to the consumer at a profit of 25 per cent; find the amount paid by the consumer for goods which cost the importer $8250.

10. The boundary lines of a field are the following: the first runs north 36 rods; the second, north-east 60 rods; the third, south 72 rods; and the fourth, west to the place of beginning, 48 rods; required the number of acres in the field.

11. The sides of a rectangle containing 34992 square feet, are as 4 to 3; find them.

12. There is a circular fish pond of 90 feet radius, surrounded by a walk 25 feet in breadth; find the area of the walk.

III.

July, 1872.

1. Prove the rule for finding G. C. M. of two numbers.

2. In the *Globe* of 21st April, gold is quoted at 111¼. Find discount % on greenbacks.

3. I invest $13450 in stock of Bank of Commerce at 134½, the half yearly dividends being 4½%. Find my annual income from the investment.

4. A farmer sold his crop of wheat in 1871 for 8% more than he obtained for his crop of the preceding year; he received for both crops $2600; how much did he get for his crop of 1870?

5. Reduce to simplest form $\frac{8\frac{3}{4}}{6\frac{1}{3}}+\frac{5\frac{3}{4}-1\frac{1}{5}}{5\frac{3}{4}+1\frac{1}{5}} \times 5\frac{9}{38}-3\frac{9}{16}$.

6. A grocer has three kinds of tea, costing 30, 45, and 60 cents a lb. respectively; what quantities of each must he take to form a mixture of 144 lbs. worth 40 cents a lb.?

7. A commission merchant sold a consignment of goods on 3% commission, and was instructed to invest (on 2% commission) in other goods, the commission for both transactions to be deducted in advance. His entire commission was $265. Find value of the goods he purchased. $5141

8. Find cost of papering a room 29 feet 6 inches wide, 36 feet 6 inches long, and 13 feet 6 inches high, with paper $2\frac{3}{4}$ feet wide, and costing $2.20 per piece of 12 yards long, the parts not requiring paper making up $\frac{1}{5}$ of whole surface.

9. Two persons travelling together agree to pay expenses in the ratio of 7 to 5. The first (who contributes the greater sum) pays away on the whole $103.20, the second $63.40. What must one pay the other to settle the affair according to agreement?

10. The sides of a triangle are 30, 40, and 50, respectively. Find the area of the triangle formed by joining the middle points of these sides.

IV.

DECEMBER, 1872.

1. Find the length of the longest chain that will exactly measure both the distances 177 yds. 1 ft. 10 in., and 289 yds. 1 ft. 2 in.

2. The true year is exactly 365 da. 5 h. 48 min. 49·7 sec., and the common year 365 da.; show that the following rule for leap year will render the calendar cor-

rect to within one day, for a period of 4000 years:—(1.) Every year that is exactly divisible by 4 is a leap year, the centennial years excepted; the other years are common years. (2.) Every centennial year that is exactly divisible by 400 is a leap year; the other centennial years are common years.

3. A and B engage in trade; A invests \$6000 and at the end of 5 months withdraws a certain sum. B puts into the business \$4000 and at the end of 7 months \$6000 more: at the end of the year A's gain is \$5800, and B's is \$7800. Find the amount that A withdrew.

4. A pound (Troy) of standard gold (22 carats fine) is coined into 45 guineas; if the value of the alloy be $\frac{11}{239}$ that of an equal weight of pure gold, find the value of the alloy per pound avoirdupois.

5. Find the square root of 5 to 10 places of decimals, and deduce the values of $\sqrt{\frac{1}{5}}$, $\frac{\sqrt{5}+1}{\sqrt{5}-1}$, $\sqrt{0.5\dot{5}}$.

6. A sold to B a lot of tea which cost him \$1200, B sold it to C, who disposed of it for \$1597.20: if each of the three merchants gained the same rate per cent., find the prices at which A and B sold the tea.

7. When exchange at New York on Paris is 5 francs 16 centimes per \$1, and at Paris on Hamburg $2\frac{1}{8}$ francs per marc banco, what will be the arbitrated price in New York of 11520 marc bancos of Hamburg?

8. If the specific gravity of coal be 1·250, how many tons of coal (28 lbs. to the quarter) in a square mile of coal seam whose average thickness is 80 feet?

9. A grocer mixes 70 lbs. of tea with 40 lbs. of a better quality, and finds that the mixture is worth $62\frac{3}{11}$ cents per lb., the difference in the prices being 20 cents. find the price of each kind.

10. A grain dealer expended a certain sum of money in the purchase of wheat, half as much again in the purchase of barley, and twice as much in the purchase of oats; he sold the wheat at a profit of 5%, the barley at a profit of 8%, and the oats at a profit of 10%, receiving altogether $9740. Find the sum laid out in each grain.

11. The sides of a rectangular field containing 27 A. 1 R. 8 P., are as 21 to 13; find the perimeter of the field.

12. Two adjacent sides of a parallelogram are 30 yards and 40 yards respectively; one of the diagonals is 50 yards; find the other.

V.

July, 1873.

1. Show that L. C. M. of two or more fractions in lowest terms is the L. C. M. of their numerators, divided by the G. C. M. of the denominators: and that their G. C. M is the G. C. M. of the numerators divided by the L. C. M. of the denominators.

2. Find in grains the least weight that can be expressed by an exact number of ounces in both Troy and Avoirdupois weight.

3. Prove the rules for converting the various kinds of decimals into vulgar fractions.

Shew that, in converting a fraction in its lowest terms to a decimal, the result will be a finite decimal, or a mixed circulating decimal, or a pure circulating decimal, according as the denominator contains only the factors of 10, *other* factors also, *none* of such factors.

4. The officers of a regiment are ·042 of its whole strength; 50 privates are added, and then the officers

are ·040 of the whole. Find the number of officers and the entire number of men in the regiment at first.

5. Prove the rules (without formulas) for (1) Simple Interest, (2) Discount, (3) Compound Interest.

6. A man has capital which he invests to produce 5 % per annum; every year he adds one-fourth of his income to his original investment: in how many years will his income be three times what it was the first year, given log. 2 = ·301030, log. 3 = ·477121 ?

7. Give complete explanations of the analyses of the following questions: (1.) An agent received $56 for selling grain on a commission of 4 %; find value of grain sold. (2.) A person receives $600 from an 8 % bank dividend; how much stock does he own? (3,) Sold stock at a discount of 7$\frac{3}{5}$ %, and make a profit of 5 %; at what rate of discount was the stock purchased? (4.) A shipment of flour was insured at 4$\frac{3}{8}$ % to cover $\frac{5}{8}$ of its value, the premium paid being $122.50; what was the flour worth?

8. My agent in Montreal sold a shipment of flour at $8 a barrel on a commission of 3 %; I then instruct him to purchase certain goods for me on a commission of 2 %; his whole commission was $500; find how many barrels of flour were shipped.

9. Give analyses for (1) the different cases of Profit and Loss; (2) Partnership.

10. The rain which fell during a certain shower on the roof of a rectangular building, 135 feet long and 99 feet wide, filled a cistern 8 feet long, 6 feet deep and 3 feet broad; how many (long) tons of water fell during that shower on an adjoining field of 6 acres?

VI.

DECEMBER, 1873.

1. When greenbacks are at a discount of 16⅔, what is the price of gold ?

2. State and prove the rules for converting the different kinds of decimals into vulgar fractions.

3. Water expends 10% in freezing; find the weight of water in a solid piece of ice whose dimensions are 12 ft., 8 ft., 5½ ft. (cubic foot water weighs 1000 ounces.) 15 tons

4. Show that the sum of

$\sqrt{0.79\dot{0}1234567\dot{9}}$ and $\sqrt{0.\dot{0}1234567\dot{9}}$ is unity.

5. Show (no formulas) how to find the (true) discount on a sum of money for a given time and rate. How much may be gained by hiring money at 5% to pay a debt of $6400, due 8 months hence, allowing the present worth of this debt to be reckoned by deducting 5% per annum discount ? $7 1/9

6. A person having $5000 Bank Stock, sells out when it is at 40% premium; what amount of money does he receive, brokerage being ⅛% ?

7. If a piece of silk cost 80 cents a yard, at what price shall it be marked that the merchant may sell it at 10% less than the marked price, and still have 20% profit ? $1.06 2/3

8. A merchant in Toronto has $4800 due him in Halifax; how much more will he realize by having a draft for this sum on Halifax and selling it at ½% discount, than by having a draft on Toronto remitted to him, purchased in Halifax for this sum at ¾% premium ? $11.73+

9. A and B are partners. A's capital is to B's as 5 to 8; at the end of four months A withdraws ¼ of his

capital, and B ¾ of his; at the end of the year their whole gain is $4000; how much belongs to each? A $1714 2/7 B 2285 5/7

10. A commission merchant in Montreal sells for a Toronto merchant 800 bbls. flour at $6.87½, on a commission of 3%, and buys certain goods required by his Principal, on a commission of 2% on the price paid for the goods, taking his commission out of the money in hand. Find whole amount of commission. $250

11. A person sold two horses at $160 each, losing 20% on one and gaining 20% on the other. Did he gain or lose on the whole transaction, and how much? $13 1/3

s-tone

12. The side, BC, of an equilateral triangle ABC, is 30 feet; lines are drawn from the angles, B, C, bisecting the opposite sides, and intersecting in D. Find the area of the triangle BDC. $75\sqrt{3}$ sq ft.

VII.

June, 1873.

1. A man invests £8068 in the 3 per cents., at 91½ the brokerage being ⅛%. What will be his clear income after paying an income tax of 10*d.* in the £? £253

2. A Toronto merchant ships to Quebec a quantity of apples, with instructions that the apples are to be sold, the two commissions of ½ % and ¾ % deducted, and the balance invested in tea. The apples were sold at $3.25 per bbl., and the agent charges for his two commissions $604. Required the number of barrels? 14979 1/5

3. Explain "Exchange between Toronto and London is at par when it is quoted at 109½." What will a bill of exchange for £1,267 15*s.* 4*d.* cost if it is purchased through a broker who charges ½ % com.? $6197.94+

$11.73+

4. Four men begin at the same time to walk round

an island 35 miles in circumference. They travel at the rate of 3, 3⅕, 3⅓, and 4⅓ miles per hour respectively. When will they all be together again ? at the starting point 1050 hours

5. A sold B a bill of goods amounting to $7,600, but B not having the money gave A a note for 3 mos., which when discounted at the bank at 6% paid the debt. Required the face value of the note ? $7715.73+ No days of grace

6. If £5 be allowed as discount off a bill of £125 due a certain time hence, what would be the discount allowed if the bill had twice as long to run ? £ 9 $\frac{8}{13}$

7. A gentleman has $25,000 of Bank of Commerce stock which pays a dividend of 8 %. When money is worth 7 % he sells out, and invests in Bank of Toronto stock at 205, which pays a dividend of 12 %. What difference in his income after allowing his agent ⅛ % commission for each transaction ? $ 338.89+

30 at 60
15 at 70
20 at 60
20 at 70

8. A grocer wishes to mix 60 lbs. of tea @ 40 cts. with tea at 60 cts. and 70 cts., so that the mixture may be worth 50 cts. How many lbs. of the other teas must he take ? Give reasons for your solution.

9. A column 1½ feet in diameter and 30 feet high has a spiral gold thread on it which makes a complete circuit in every foot of the column. Required the length of the thread ? $\frac{30}{7}\sqrt{1138} = 144.55+$ ft

10. When the course of exchange between London and Paris is 9½*d.* per franc, and 3·63 francs are equivalent to 1 Prussian thaler, and 24·5 thalers to 34 Austrian florins, and 25 Austrian florins to 12·6 Venetian ducats, if a London merchant owe to one in Venice 1000 ducats, will it be more advantageous to remit by way of Paris, Berlin and Vienna, or direct to Venice, supposing a ducat to be equivalent to 4*s.* 2*d.* ? By Paris &c

VIII.

June, 1874.

1. Explain clearly the terms *Numerator* and *Denominator*. Prove the rules for multiplication and division of fractions.

2. From the sum of ·628125 of a £, ·109375 of £5, 47·3125 of a shilling, and $\frac{3}{5}$ of $\frac{\cdot\dot{7}}{1\frac{3}{4}}$ of 1·2421875 of 13*s.* 4*d.*, take $2{\cdot}9553\dot{5}7142\dot{8}$ of a guinea.

3. If 12 men in $94\frac{1}{2}$ days, working 10 hours a day, dig a trench $33\frac{3}{4}$ yd. long, $2\frac{2}{3}$ yd. deep, and $2\frac{3}{8}$ yd. wide, how many hours a day must 217 men work to dig a trench $23\frac{1}{4}$ yd. long, $2\frac{1}{3}$ yd. deep, and $1\frac{5}{8}$ yd. wide, in 11 days?

4. If ·08 is the *yearly* rate of interest (compound) per unit, what is the rate per *quarter*? If the quarterly rate of interest be ·02 per unit, find the true yearly rate.

5. Three men form a partnership, each contributing the same amount of capital; one of them is appointed manager, and as such is to receive 12½% before the dividends are paid. When the business is wound up the manager receives altogether, $6000. What were the total profits? $14 400

6. One company guarantees to pay 6% on shares of $100 each; another guarantees at the rate of $5\frac{4}{5}$% on shares of $30 each; there price of the former is $124.50, and of the latter $34. Compare the rates of interest which they return to the purchaser. $4\frac{68}{83}$ & $5\frac{2}{17}$ %

7. By selling cloth at $1.20 per yard, a tradesman gained 2½% on his outlay; at what price must he sell it to gain 12½%? $$1.31\frac{29}{41}$

8. Find the length of the longest chain, in terms of which 88 yds. 2 ft. 5 in., and 119 yds. 2 ft. 1 in. can both be expressed as integers. 11 ft 7 in

9. A person has $10000 Bank of Montreal stock which is at 185, and pays a half-yearly dividend of 5%; he sells out, and invests in Dominion Bank stock, which is at 108, and pays a half-yearly dividend of 3½%. Find by what amount his semi-annual income is increased or diminished. $99.53+ increase

10. A wall whose height is 4 times its thickness, and whose length is 10 times its height, contains 2500 cubic feet. Find the dimensions of the wall. 2½ × 10 × 100 ft.

11. Within a circular garden 70 chains in circumference, is a circular pond, 70 rods in circumference. Find the width of the ring of land which surrounds the pond. 33 9/22 rods

IX.

July, 1874.

1. Find the quotient (expressed as a vulgar fraction) of

$$1\tfrac{1}{2}+\frac{\frac{3}{5}\text{ of }4\frac{1}{2}}{\frac{9}{10}}-\frac{5\frac{1}{3}}{8}-\frac{4\frac{1}{2}-1\frac{2}{3}\text{ of }1\frac{4}{5}}{\frac{1}{3}+\frac{1}{6}+\frac{1}{12}+\frac{1}{24}}\text{ divided by }1\tfrac{1}{2}\text{ of }3\tfrac{3}{4}+\cdot0\dot{1}\dot{6}+\frac{1\frac{1}{3}-\frac{1}{4}}{2\frac{1}{2}+\frac{1}{3}}+\frac{1\cdot25}{\cdot08}.$$

$\frac{454}{1251}$

2. If a number be increased 20%, and the amount be increased 16⅔%, the result will be 280; find the number. 200

3. Twenty men can do a piece of work in 12 days; find how many men will do half as much again in one-fifth part of the time, supposing that they work the same number of hours in the day, and that two of the

second set can do as much work in an hour as three of the first set. 100 men

4. A grocer intended to gain 8 % on a stock of tea, and fixed his price accordingly; when he had sold two-thirds of the stock he was compelled to reduce the price 10 cents a pound, and so gained only half as much as he had intended. What was the original cost per lb. of the tea? 83⅓¢

5. Shew that $\frac{3\sqrt{8}-2\sqrt{7}}{\sqrt{8}-\sqrt{7}}=17{\cdot}483$.

6. A sells goods to B at a loss of 4 %, B sells them to C at a loss of 6¼ %, C sells them to D for $390.60, gaining 8½ %; find the prime cost of the goods. $400

7. A and B invest capital in the proportion of 3½ to 4. After five months A withdraws one-half his capital, and B withdraws two-thirds of his. At the end of the year they have gained $7,090; find each man's share.
A's = $3570 B's $3520

8. A bankrupt has book debts equal in amount to his liabilities, but on $24,000 of them he realizes only 66⅔ cents in the dollar, and the expenses of the bankruptcy are 5 % on the book debts; he pays 65 cents in the dollar; find the amount of his liabilities. $26 666 2/3

9. A merchant in Boston has 10,000 francs due him on account in Paris; he can draw on Paris for this amount, and negociate the bill at 19⅖ cents per franc, or he can advise his correspondent in Paris to remit a draft on Boston, purchased with the sum due him, exchange being at the rate of 5 francs 20 centimes per dollar. What sum does he save by adopting the more profitabfe course? $16.92 4/13

10. How many flagstones, each 5·76 ft. long and 4·15 ft. wide, are required for paving a cloister 12·45 ft.

wide which encloses a rectangular court 45.77 yds. long and 41·93 yds. wide? 300

11. When the 3 per cents are at 96, how much stock must be sold out to pay a bill of £1,664, 9 months before it becomes due, real discount being allowed at 4½ % per annum? £ 1676 $\frac{1844}{2481}$

12. A pile of bricks in the form of a parallelopiped contains 3000 cubic feet, and the length, breadth and thickness are as 4, 3 and 2 respectively; find the dimensions of the pile. 20, 15, 10

X.

July, 1874.

1. Capital originally invested so as to yield an annual income of $22500, at the rate of 9%, is re-invested at 10%, and then divided among three persons in shares which are as 4, 7 and 9. What is the yearly income of each? $5000, $8750, $4250

2. If U. S. 6's 5-20 can be purchased at 107½ in currency, interest payable in gold, and railway bonds bearing 7% interest payable in currency can be bought at 85%, determine the respective rates of yearly interest yielded by these investments, assuming that the premium on gold is 25%, and that the railway bonds are subject to a tax of 1½%. 6 $\frac{42}{43}$ 6 $\frac{8}{17}$

3. A merchant sells two qualities of flour, the superior at $6 a barrel, the inferior at $5 a barrel; in the month of April he sold 150 barrels, receiving therefor $810. How many barrels of each kind did he sell?
60 at 6 + 90 at 5

4. If a merchant sells on credit to a retail grocer, on the 1st of November, goods to the amount of $100; on the 6th, goods to the amount of $225; on the 18th, goods to the amount of $180; on the 22nd, goods to the amount of $75; and on the 29th, goods to the amount of $120. Find the equated time at which the whole debt for the month becomes due. Nov 14th

5. A man having bought a lot of goods for $750, sells one-third at a loss of 4%; by what increase per cent. must he raise that selling price, in order that by selling the rest at the increased rate, he may gain 4% on the whole transaction? $12\frac{1}{2}$%

6. The value of paper required for papering a room, supposing it $\frac{3}{4}$ of a yd. wide, and $4\frac{1}{2}d.$ a yd., is £2 3*s.* $1\frac{1}{2}d.$; what would be the cost if the paper was two feet wide, and 4*d.* a yard? same

7. A New York merchant shipped to Liverpool 10,000 bushels of wheat which cost, delivered, $2.15 in currency per bushel, he sold it for 7*s.* 6*d.* a bushel, and invested the proceeds in cottons at 8*d.* a yard, which, after paying an *ad valorem* duty of 30%, he sold at 30 cents a yard in currency. Determine his profits from these transactions, gold being at $37\frac{1}{2}$% premium. $8375

£1 taken as $\$\frac{40}{9}$, find gain in currency

8. If 36 men working 8 hours a day for 16 days, can dig a trench 72 yards long, 18 wide, and 12 deep; how many men will dig, in 24 days, a trench 64 yards long, 27 wide, and 18 deep? 48 men

9. A man sells 576 bushels of wheat at a profit of 8%, and 296 bushels at a profit of 12%; had he sold the whole at a uniform profit of 10%, he would have received £2 14*s.* 3*d.* more than he actually did; what was the price per bushel paid for the wheat? $9\frac{11}{16}$ S

10. (*a*) The height of a tower on a river's bank is 50 feet, the length of a line from its top to the opposite bank is 65 feet; find the breadth of the river.

[illegible]

(*b*) The content of a cistern is the sum of two cubes whose edges are 10 inches and 12 inches respectively, and the area of its base is the difference of two squares whose sides are $1\frac{1}{9}$ ft. and $1\frac{2}{9}$ ft. respectively; find its depth. $73\frac{1}{14}$ in

XI.

December, 1874.

1. The first of six boys can copy 8 lines as soon as the second can copy 2; the second 5 as soon as the third 6; the third 7 as soon as the fourth 8: the fourth 9 as soon as the fifth 10, the fifth 15 as soon as the sixth 14; how many lines will the sixth copy while the first is copying 135? 129

2. The hour, minute and second hands of a clock turn on the same centre and are together at 12 o'clock; how long before the second hand will be midway between the other two? $30\frac{390}{1427}$ sec

3. A person imported a quantity of goods, paying 15% for freight and insurance, and 10% duty. He sold them at a loss of 10%; but if he had sold them for $600 more than he actually received, he would have made a profit of 2%. Find the original cost of the goods. $4000

4. When exchange at New York on Paris is 5 francs 80 centimes to the dollar; that at London on Paris 26 francs 20 centimes to the pound sterling; and that at New York on London 9% premium; how much less will it cost a merchant to remit 2000 francs to Paris by circular exchange through London, than by direct exchange? $7,534

5. A contractor tenders for a certain work at $20,000,

to be paid at completion of the work; another tenders for it at $19,400, stipulating that $2000 shall be paid him every three months; find the difference of the tenders supposing the work in both cases to be finished in two years, and money to be worth 8%. $520 at end of time

6. Two partners gain $4800; A puts in $5600 more than $\frac{1}{3}$ of the whole stock, and his share of the gain is $2600. Find the stock contributed by each. A$14560 B$12320

7. A rectangular court is 80 yds. long and 50 yds. broad; it has paths 6 feet wide joining the middle points of the opposite sides, and also paths of the same breadth running all round it on the inside; the remainder is covered with grass; if the paths cost 1*s*. 8*d*. per square foot, and the grass 3 shillings per square yard, find the whole cost of laying out the court. £1046 " 8 8

8. A speculator paid $1400 for two lots, the price of one of them being 40% that of the other. He sold the cheaper lot at a gain of 50%, and the dearer one at a loss of 30%. Find his gain or loss per cent. on the whole transaction. Loss = $7\frac{1}{7}$%

9. A has £90,000 stock in the 3% South Sea Annuities and is offered by Government the choice of being paid off at par at the end of the year, or of receiving £110 of the new $2\frac{1}{2}$% stock for each £100; he choses the former alternative, and invests his money in the 3 % consols at 92. Find the amount of his stock in consols, and the excess of his income above what it would have been if he had agreed to the proposed conversion. £97826 2/23 £459 18/23

10. (1) A rectangular piece of ground whose sides are in the ratio of 2 : 3 contains 2300 square yards; find the sides. 39.15+ 58.73

(2) If it cost $200 to enclose a circular pond contain-

ing 4a. 2r. 10p.; how much will it cost at the same rate to enclose another containing 25a. 0r. 15p.?

$469.04 +

XII.

July, 1875.

1. A person sells $6000 Canadian bank stock, which pays half-yearly dividends at 4%, at 112, and invests in American railway stock at 98¾. What yearly dividend should the latter stock pay in order that his income may be unchanged, gold being quoted at 112¾? 7 3/56 %

Dividend on R.R. Stock paid in U.S. Currency

2. Incomes below £150 a year being subject to 5*d.* in the pound income tax, and incomes above £150 to 7*d.* in the pound; find what income above £150 a man must have that he may be just 7¾*d.* a year poorer than a man who has £149 10*s.* a year. £150 " 15

3. The hour, minute, and second hands of a clock move on the same centre and are together at 12 o'clock; at what time will the hour hand be midway between the other two? 5-9 13/73

4. A owes $15,000 bearing interest at 5% per annum; he pays at the end of each year for interest and part payment of principal $2500; find the amount of his debt at the end of the third year. $9483.12½

5. A man began business with a certain capital; he gained 20% the first year, which he added to his capital, and 37½% the second year, which he added to his capital; in the third year he lost 40%; had he received $600 more for the goods sold the last year, he would have cleared in the three years 2 per cent. of his original capital. Find the capital with which he commenced business. $20000

6. A man borrows £5000, and agrees to pay principal and interest in four equal semi-annual payments; find the amount of each payment, interest being 5% per half year. £ 1410.05 Compd Int.

7. A merchant sold goods for which he received a 45 days' note, which he immediately discounted at the Bank of Commerce at 6%. The discount was $\$38.70\frac{24}{25}$; find the face of the note. $5232.96 4/9 No days of grace

8. Exchange between Paris and Amsterdam being at the rate of 2 francs 20 centimes to the guilder, that between London and Parts at the rate of 25 francs 80 centimes to the £, and that from New York on London at 9½% premium, what will be the cost of a remittance for 1000 guilders from New York to Amsterdam by bills of exchange through London and Paris? $416. nearly

9. A coal company's net earnings are $5368, and it pays $4000 in dividends on 2500 shares, each $20 par value; what per cent. does it pay, and how much surplus does it retain? 8% + $1368 surplus

10. A broker receives $42100 to invest in U. S. 5-20 bonds, after reserving ¼% on the par value of the amount purchased. What was his commission, the bonds being at a premium of 5%? $100

11. (1) What is the difference in the cost of fencing a square 10 acre field and a circular field of the same area, the fence cost $5 a rod? (2) Find the side of the largest square stick of timber that can be sawed from a log 30 inches in diameter. (1) $92 nearly (2) 15√2

XIII.

JULY, 1876.

1. Find the difference between

$$\left(\frac{\cdot 26 + \cdot 2 \text{ of } 3\cdot 7}{\cdot 48 - \cdot 014 \text{ of } 20} - \frac{4\cdot\dot{3} + 5\cdot\dot{6}}{7\cdot\dot{4} - \cdot\dot{2} \text{ of } 11}\right) \text{ of } £1\ 10s.\ 6d.$$

and $\left(\frac{\frac{1}{2}\text{ of }\frac{8}{9}\text{ of }7\frac{1}{5}}{\frac{1}{3}+4\frac{1}{2}\text{ of }\frac{4}{27}}+\frac{\frac{4}{5}-2\frac{1}{3}+1\frac{8}{15}}{\frac{7}{95}+750\frac{6}{19}-74\frac{3}{5}}\right)$ of £1 5*s*. 6*d*.

2. Show that bank discount exceeds true discount by the simple interest on the true discount. Find the amount which a banker gains by discounting a bill of $2451.50, drawn 12th of July at 4 months, and discounted September 3rd, at 5 per cent. per annum, usual days of grace; give answer to exact fraction of a cent. $ .24 $\frac{55}{202}$

3. A retail merchant bought a quantity of Canadian tweed, and marked it at an advance of 25 per cent. on cost, and in selling it used a yard measure which was $\frac{3}{4}$ of an inch too short, his entire gain being $124.80; find the cost price of the cloth, and the amount the merchant gained by using the false measure. $451.20 & $112

4. A person invests a certain sum (U. S. currency) in U. S. 5's 10-40 (*i.e.* certain bonds paying 5 per cent.), and $70\frac{10}{19}$ per cent. more than that sum in U. S. 6's 5-20, the former being at a discount of 5 per cent., and the latter at a premium of 8 per cent., and the interest on both payable in gold. His interest from the two investments was $1400 in gold. Find the amount (currency) invested in each kind of bonds. $9500 in 5 %'s
$16200 " 6 %'s

5. Three workmen, A, B and C, did a certain piece of work and were paid daily wages according to their several degrees of skill. A's efficiency was to B's as 4 to 3, and B's to C's as 6 to 5; A worked 5 days, B 6 days, and C 8 days, and the whole amount paid for the work was $36¼. Find each man's rate of wages per day. A $2.50 B $1.87½ C $1.56¼

6. A merchant in Montreal owes another in Lisbon $1023\frac{3}{5}$ milrees, and he resolves to remit through London, Amsterdam and Paris; exchange between Montreal and

London is at 9½ per cent., between London and Amsterdam £1 sterling for £1$\frac{33}{50}$ Flemish, between Amsterdam and Paris £1 Flemish per 18 francs, and between Paris and Lisbon 3 francs per 450 rees; if the expenses of this circuitous course be 2½ per cent., what will it cost the Montreal merchant to settle his Lisbon account? (1000 rees=1 milree. $2188.131 See p 14.

7. I bought a hind quarter and a fore quarter of beef weighing together 252 lbs.; I paid 7¼ cents a pound for the hind quarter, and 5½ cents a pound for the fore quarter, and found that I had paid 17½ cents on the whole more than if I had bought both quarters at 6⅜ cents per pound; find the weight of each quarter. 116 at 5½ + 136 at 7¼

8/12

8. A person bought a piece of land for $1000, to be paid in 5 years with interest at 10 per cent.; he was allowed a choice of two modes of payment, (1) he could leave the principal unpaid till the end of the five years, paying the interest due annually; (2) he could pay $200 of the principal each year together with the accrued interest; money being worth 10 per cent. compound interest, determine whether one of these modes was more profitable than the other, and how much his land will ultimately cost him. $1610.51 each way

9. A merchant bought 400 lbs. of tea and 1600 lbs. of sugar, the cost of the latter per lb. being 16⅔ per cent. that of the former; he sold the tea at a profit of 83⅓ per cent., and the sugar at a loss of 20 per cent., gaining, however, on the whole, $60; find his buying prices and his selling prices. $.75 & $.12½ ; $1 + 10¢ selling.

10. (*a*) Two towers 40 feet and 50 feet high respectively, are standing in the same horizontal plane 120 feet apart: how far from each tower is that point in the

line joining their bases, which is equally distant from their summits? 63¾ + 56¼ ft

(*b*) Two adjacent sides of a parallelogram are 25 feet and 35 feet respectively, and one of the diagonals is $10\sqrt{12}$; find the other diagonal. 50 ft.

XIV.

INTERMEDIATE—JULY, 1876.

1. Simplify £ 6 „ 16 S „ 5 D

$$\tfrac{4}{5}(3\tfrac{1}{3}+1\tfrac{1}{4})£ + \frac{1\frac{1}{8}-\frac{1}{3}\text{ of }1\frac{5}{6}}{\frac{1}{10}\text{ of }3\frac{1}{3}+\frac{13}{72}} \times \cdot 95 \text{ of } 5s. + \frac{8\cdot 4}{\cdot 012}d.$$

A $\frac{125}{52}$
B $\frac{115}{52}$
C $\frac{25}{52}$

2. A and B can do a piece of work in 3¼ days, A and C in 5⅕ days, and B and C in 5 5/7 days. If $15 be paid for the work, what wages does each man earn per day?

3. A person buys a lot of land at $120 an acre, and by selling a portion in allotments he makes 90% on all he sells, so that after reserving 20 acres, he finds that he has realized on the remainder $840 more than the entire lot cost him. How many acres did he buy? 50 ac.

4. A Toronto merchant owes £900 in Liverpool, G. B. He determines to remit to Paris at 5 francs 50 centimes per $1; thence to Hamburg at 185 francs per 90 marcs; thence to Amsterdam at 18½ stivers per marc; thence to Liverpool at 220 stivers per £ sterling: how much must he remit to discharge his debt in Liverpool, and how much does he gain over direct exchange at 9½% premium? $4000 $380 gain

5. A man invests $19450 in Bank of Montreal stock at 194, and $19,850 in Bank of Toronto stock at 198, paying his broker in each case ½% on the amount of stock purchased. If the former pays a half-yearly dividend of 6½%, and the latter a half-yearly dividend of 6¼%, find his total income for the half-year. $1275

6. Coffee, costing 35 cents per pound, is mixed with chicory worth 10 cents a pound, in the proportion of 5 pounds of coffee to 2 pounds of chicory, and the mixture is sold for 34 cents a pound: find the gain %. 22 2/39

7. A person invests the present worth (true discount) of $80,192 (due six months hence, at 4% per annum) in Bank stock paying 6% yearly interest and selling at 92½; his taxes amount to 6⅔% of his gross income from the above investment: find his net annual income. $1792

8. A and B invest capital in the proportion of 4 to 5 in business; at the end of 6 months A withdraws ⅖ of his capital, and B ⅗ of his. At the end of the year there is found to be a gain of $4,050; how is this to be divided? A $1934 22/67 B $2115 45/67

9. (1.) In multiplication, why are the successive partial products not placed directly over one another?

(2.) Can the multiplier be a concrete number? Explain clearly the meaning of the factors in 5 ft. × 3ft. =15 sq. feet.

(3.) Is a fraction a number? Explain fully why ⅘ has the same value as 12/15.

10. Find within an inch the length of a side of a square field which contains two acres.

XV.

INTERMEDIATE—DECEMBER, 1876.

1. Divide ·0075 by 25·6, and explain the reason for fixing the position of decimal point in the quotient.

2. Supposing the rate of carriage to be diminished ¼ after the first 50 miles, find the cost of carrying 18

cwt. for 80 miles, when 24 cwt. can be carried 75 miles for 5*s.* 10*d.* 4 S. 7½ D.

3. If the difference between the simple and compound interest on a sum of money for three years at 5 per cent. be $37.36, find the sum. $4899.67 +

4. A passenger in a train travelling at 30 miles per hour, observes that in just one minute he overtakes the length of a freight train running on a parallel track at 18 miles per hour; how long would he have been in passing the same train if it had been moving at the same rate in the opposite direction? 15 sec
x = length of frt. tr. y = no min req'd

5. A merchant spends $158 in purchasing black cloth at the rate of 11 yards for $10, and blue cloth at the rate of 7 yards for $4, and buys twice as many yards of blue as of black. Discovering that the black is much worse, and the blue much better than he expected, he determines to retail each kind at the rate paid for the other, and finds that had he received 7 cents more on his entire sales, he would have exceeded his usual profit by 10 per cent. of itself What was his usual percentage of profits on cloths? 15 %

6. A bookseller allows teachers 10 per cent. on all cash purchases. For ordinary customers his goods are marked at a ready money price, and at a credit price. allowing 12 months (interest at five per cent.) What must a teacher pay for goods worth £4 9*s.* 3*d.* at credit prices? £3 " 16 " 6

7. If a debt after a deduction of 3 %, becomes $1008.80, what would it have become after a deduction of 4 % had been made. $998.40

8. A, B, and C, working together, can do a piece of work in 4 days, which A and B alone can do in 5 days,

or B and C alone in 6 days. If A and C work together for $1\frac{7}{8}$ days, and A and B together for $1\frac{1}{9}$ days, how long must B and C work together, so that A, B, and C coming after them, may complete the work in $1\frac{1}{3}$ days? $1\frac{1}{6}$ days

9. If silver be worth \$1.10 per oz. and gold \$17 per oz., what will be the weight of a \$5 coin containing (by weight) 92·5 per cent. gold and the rest silver? $\frac{2000}{6323}$ oz

10. Extract the square root of $\frac{1000 \cdot 10001}{1000}$; and find the number of acres, etc., that there are in a triangular field of which the sides are 7 ch. 60 links, 9 ch. 50 links, and 5 ch. 70 links. 2a. 0r. 26 $\frac{14}{15}$ per

XVI.

C. J. McGregor, M. A.—Stratford High School.

1. A man dying left a wife and twins (son and daughter), and by his will ordered that if the daughter died before the son was of age, $\frac{2}{3}$ of the estate should belong to him, and the remainder to his mother, and if the son died before he was of age, $\frac{2}{3}$ of the estate should belong to the mother and $\frac{1}{3}$ to the daughter; both son and daughter lived till they were of age, by which the mother lost on an equitable division \$2000 more than if the son had died; what would have been her dowry had the daughter died? \$1750

2. A sells a quantity of wheat at \$1 per bushel, and gains 20 %. Afterwards he sold some of the same wheat to the amount of \$37.50 and gained 50 %. How many bushels were there in the last lot and at what rate per bushel did he sell it? 30 bush \$1$\frac{1}{4}$

3. A and B exchange goods: A puts his at \$30.24 and gains 8 %; B puts his at \$24.30 and gains at the same rate: what was the prime cost of the goods?

A's \$28 & B's 22.50

4. A and B exchange goods; A's goods cost him $28.00, B's cost him $22.00 and he asks $25.00 for them. What must A ask for his so as to gain 10 % more than B?

5. A merchant knows neither the weight nor prime cost of a certain article. He recollects that if he had sold the whole at $7.00 per lb. he would have gained $70.00, and if he had sold it at $5.00 per lb. he would have lost $30.00. What was the weight and prime cost of the article? 50 lbs + $5.60 per lb

6. The arms bearing the cups of a clock anemometer are of such a length that 4 minutes of the anememeter dial indicate one mile of wind; what distance is travelled by the wind when the hands on the dial have passed over 8h. 30m.? 127½ mls

7. In the case of the anemometer mentioned in question 6, what is the velocity of the wind in miles per hour when the hands on the dial pass over 10 minutes in 6 minutes time? 25 mls per hr

8. A tradesman marks his goods with two prices, one for ready money and the other at a credit of three months; what ratio ought the two prices to bear to each other allowing 8 % discount? true disct 50:51

9. Sold goods to a certain amount on a commission of 5 %, and having remitted the net proceeds to the owner, received for prompt payment ½ %, which amounted to $24.22½; what was the amount of commission? $255

10. A and B had the same amount of money. A spent 76 % of his for land, and B lost by trading a sum equal to 28½ % of what both had at first, when both together had $50.25. What sum had each at first, and how much had each left? $75; A $18; B $32.25

XVII.

$\frac{467}{1150578}$

1. Simplify $\frac{£7\ 5s.}{£14\ 16s.} - \frac{2\text{ tons }2\text{ qrs. }26\text{ lbs.}}{4\text{ tons }1\text{ qr. }21\text{ lbs.}}$, and $\frac{4\text{ ft. }7\text{ in.}}{4\text{ yds. }2\text{ ft.}} + \frac{16s.\ 8d.}{17s.\ 9\frac{1}{2}d.} \div 24\frac{2}{5}$ $\frac{4692}{20496}$

2. Three vulgar fractions, of which the first is $\frac{5}{11}$, the second $\frac{1}{137}$, and the third has for its numerator 7, are reduced to approximate decimals, and being then added together the sum is $1{\cdot}00030\frac{5}{8}$. Find the third fraction. 7/13

3. A merchant bought 125 yards of cloth at a uniform price per yard, and gained $8\frac{1}{2}$ per cent. by selling 88 yards of it at \$3.62 per yard, and the remainder at \$2.60 per yard. What did the cloth cost him per yard? \$3.05+

4. If 6 yards of silk cost as much as 15 yards of flannel or 40 yards of calico; and if 19 yards of silk, 17 of flannel, and 22 of calico, together cost \$37.83; find the price per yard of each article. \$1.30, \$.52, \$.19½

5. If 69 German thalers, of which 9 parts in 10 are fine silver, weigh 41 ounces, and English standard silver $\frac{37}{40}$ fine is worth \$1.23 per ounce; find the value of a thaler in English money, assuming the £ sterling to be worth \$4.80. $35\frac{473}{851}$ d

6. Along a certain path 1600 yards long, there is a house every 50 yards, and a tree every 20 yards; how many houses will have a tree in front? 17 counting, at each end

7. A young man's salary increased $\frac{1}{3}$ every year; his expenses each year were $\frac{1}{3}$ of his salary, and at the end of 4 years he had saved $\$1001\frac{1}{27}$. Find his first year's salary. $\$231\frac{112}{175}$

8. What will be the amount (compound interest) of \$2,400 for $1\frac{1}{4}$ years, at 10 per cent. per annum, paid

\$2778.30; $10\frac{61}{120}$ %

half-yearly; and at what rate, simple interest, will it amount to the same sum in the same time?

$2222 2/9
$4444 4/9
$3333 1/3
$ 10000

9. Four persons form a partnership, the second puts in twice as much capital as the first, the third half as much as the first and second together, and the fourth as much as the other three. How should a profit of $20,000 be distributed among them?

10. An importer sold cloth to a wholesale dealer at 10 per cent. advance; the wholesale dealer sold it to a clothier at an advance of 12½ per cent.; the clothier sold it at a farther advance of 25 per cent., and received $726. How much did it cost the importer? $469 1/3

XVIII.

1. Find the value of $\frac{25{\cdot}75+7{\cdot}5}{2{\cdot}87+11{\cdot}38}$ of £1·25 − ·8791$\dot{6}$ of £1 + ·40$\dot{8}$7301$\dot{5}$ of a guinea − ·$\dot{6}$7832$\dot{1}$ of 11*s*. 11*d*.

£2 " 1S " 3D

2. What is the value of a wedge of pure gold weighing 3 lbs. 8 oz. 6 dwts. 16 grs., when standard gold is worth £3 17*s*. 10½*d*. per oz. (neglecting the value of the alloy), pure gold being to standard gold as 12 to 11?

£188 " 6S " 3 9/11 D

3. A bottle, which when empty weighs 520 grains, holds 1500 grains of water, and when filled with alcohol it weighs 1708 grains; if a cubic foot of water weighs 1000 ounces, what is the weight of a gallon (= 277¼ cubic inches) of alcohol? 127.07+ oz

4. A and B run a 100 yards race, and A wins by 2 yards; C and D run over the same course, and C wins by 6 yards; B and D also run over it, and B wins by 4 yards. If A and C run, which will win and by how much? C by 25/394 yd.

5. A commission merchant in Montreal sold 816

barrels of flour for a Toronto merchant on a commission of $2\frac{1}{3}$ per cent., and purchased with the proceeds black tea at 60 cents a pound on a commission of 2 per cent. on the price paid for the tea; he took his commission for both transactions out of the price received for the flour. His entire commission being $200, find what price was received for the flour, and what quantity of tea was purchased. $5 5/9 a bbl ; 7222 2/9 lbs

6. Find a fraction equivalent to $\frac{5}{13}$, and having its numerator 44 less than its denominator. $\frac{27\frac{1}{2}}{71\frac{1}{2}}$

7. A man skates 6 miles at the rate of 10 miles an hour with the wind, and returns against it in 50 min. How much does the wind accelerate or retard him? 7/5 ml per hr

8. Bought 236 yards of cloth at $1.89 a yard, and sold one-fourth of it at $2.46 a yard, one-third at $2.04, and the remainder at $1.68 a yard; find the gain or loss per cent. on the whole outlay. 5 5/9 % gain

9. If the discount on £567 be £34 14*s.* $3\frac{3}{7}$*d.*, at $4\frac{1}{2}$ per cent., when is the sum due? $1\frac{31}{69}$ yrs

10. A grocer bought a stock of tea intending to gain 20 per cent. on its sale; when he had sold two-thirds of it he was compelled to reduce the price 8 cents a pound, and so gained on the whole only $77\frac{7}{9}$ % of what he had intended. Find what price he paid for the tea. 60¢ per lb

XIX.

1. Simplify

$$\frac{4\frac{2}{3}-1\frac{5}{7}}{8\frac{5}{6}+\frac{7}{24}} \text{ of } \frac{3\frac{5}{12}-1\frac{2}{11}}{11\frac{1}{6}-6\frac{8}{15}+3\frac{1}{10}} \text{ of } \frac{6\frac{3}{5} \text{ of } \dfrac{\frac{33}{34}}{1\frac{31}{68}}}{1\frac{2}{29} \text{ of } 2\frac{2}{5} \text{ of } 5\frac{9}{10} \text{ of } \frac{5}{14} \text{ of } 1\frac{3}{47}}$$ $\frac{1}{6}$

2. If 60 guns firing 5 rounds in 8 minutes kill 350 men in $1\frac{1}{4}$ hours, how many guns firing 7 rounds in 9

minutes will kill 980 men in 25 minutes at the same rate? 405 guns

3. A boy is engaged for 28 days at 60 cents a day, with the condition that for every day he is idle, instead of receiving anything he is to pay 24 cents for his board; he receives altogether $12.48. How many days was he idle? 5 1/7 days

4. The exchange between Russia and England is 6.28 roubles for £1, between Russia and America 6.28 roubles for $4.55, and between America and England $4.85 for £1. Find the gain in transmitting 6000 roubles through England to America. $286.62+

5. A coin whose weight is $\frac{2000}{6323}$ of an ounce contains 37 parts in 40 of gold, and 3 in 40 of silver; the gold is worth $17 an ounce, and the silver $1.10 per ounce. Find the value of the coin. $5

6. A and B form a partnership, A contributing $5500, and B $3500; they agree that $120 shall be annually put by as an insurance fund, and the remaining profits be divided in proportion to the capital contributed, at the end of the year A gets $485.41⅔. Find the percentage of profit realized on the entire capital. 9 1/4 %

7. Owing a man $538.05, I give him a 60 days' note; what must be the face of the note to pay him the exact debt, when discounted at the rate of 10 per cent. per annum? Allow days of grace. $547.50

8. A speculator sold stock at a discount of 7⅗%, and made a profit of 5%; at what rate of discount had he purchased the stock? 12 %

9. I paid 5% interest on a sum of borrowed money; after a time I paid an instalment of $200, and had the interest on the remainder reduced to 4%, and the

yearly interest was now 33⅓ % less than before. Find the amount of the debt. $1200

10. The periods of three planets which move uniformly in circular orbits round the sun, are respectively 200, 250, and 300 days. Supposing their positions relatively to each other and to the sun to be given at any moment, determine how many days must elapse before they again have exactly the same relative positions. 3000 days

XX.

1. Find the value of

$$\frac{11{\cdot}0\dot{5}-6{\cdot}975}{1{\cdot}\dot{1}\dot{8}\text{ of }1{\cdot}\dot{2}}-\left(\frac{{\cdot}\dot{6}2\dot{9}\text{ of }2{\cdot}13\dot{8}}{7{\cdot}25+{\cdot}08\dot{3}}\text{ of }\frac{8{\cdot}61\dot{3}-6{\cdot}21\dot{3}}{5{\cdot}\dot{6}\text{ of }{\cdot}4\dot{6}}\right)$$ 2.658$\dot{3}$

2. The annual consumption of spirits in a country is 4,500,000 gallons, and the duty is $2 a gallon; the duty is reduced 4 per cent., and the consumption is incresed 6 per cent.; how is the revenue affected? $158400 increase

3. If 12 men do a piece of work in 21 days, in what time will 10 men do a piece of work 1¾ as great, if 3 of the first set do as much in an hour as 4 of the second set do in an hour and a half, and the second set work half as long again as the first? 58 4/5 days

4. If at Toronto exchange on Liverpool is at 9⅜ premium, and at Liverpool exchange on Paris is 26 francs 86 centimes per £1; find the arbitrated course of exchange between Toronto and Paris through Liverpool, and what a Toronto merchant must pay to discharge a debt of 10,000 francs. $1809 $1809.79

5. A lump of metal worth $1368 is formed by a fusion of gold and silver, the values of which are $18.60, and $1.20 an ounce respectively; the weight of

the gold is ·75 of the whole weight. Find the weight of each metal contained in the mixture. 72 oz gold 24 oz silver

6. A man invested a certain sum in Bank of Commerce stock, which is at 120, and pays $4\frac{3}{8}$ % half-yearly dividends; and $62\frac{1}{2}$ per cent. more than that sum in Dominion Bank stock, which is at 130, and pays $4\frac{1}{2}$% half-yearly dividends; his half yearly income from both investments is $222.50. Find the amount of money invested in each kind of stock. $2400 & $3900

7. A person mixes 22 lbs. of tea with 10 lbs. of an inferior quality costing 24 cents a lb. less, and gains 16% by selling the mixture at $1.74 per lb. Find the cost of each kind of tea $1.57½ $1.33½

8. If $1\frac{1}{4}$ ounces of gold 18 carets fine be worth £5 11*s.* 5*d.*, of what fineness must gold be in order that $13\frac{1}{2}$ dwts. of it may be worth £2 7*s.* 9*d.*? 20¢

9. A person bought a quantity of goods for $227.92 payable in 12 months' time, and sold them at once for $275.56 payable in 9 months' time. What is the gain in ready money allowing true discount at $4\frac{1}{2}$ per cent.? $48.45+

10. A sum of money is divided between A and B in the ratio of 5 to 3; and A's share exceeds $50 by $55\frac{5}{9}$ per cent. of the whole sum divided. Find the share of each. $450 ; $270

XXI.

1. Simplify $\dfrac{9(3\frac{4}{7} \text{ of } \frac{7}{15})}{5\left(\dfrac{6}{\frac{4}{5}} \text{ of } \frac{2}{5}\right)} \div \dfrac{\frac{4}{7}}{1\frac{1}{7}} \left(\dfrac{1\frac{4}{5} \text{ of } 3\frac{1}{3}}{\frac{5}{12} \text{ of } 4\frac{4}{5}}\right)$ and reduce $\frac{6}{7}$ of $1\frac{3}{4}$ of £3 14*s.* 9*d.*, to the fraction of £6 10*s.* $9\frac{3}{4}$*d.*

2. There are three fractions whose sum is $\frac{536}{567}$, and 9 times the first, 12 times the second, and 14 times the third are equal. Find the fractions. $\frac{32}{81}$ $\frac{8}{27}$ $\frac{16}{63}$

3. A banker in Montreal remits \$3,000 to Liverpool as follows: first to Paris at 5 francs 40 centimes per \$1; thence to Hamburg at 185 francs per 100 marcs; thence to Amsterdam at 35 stivers per 2 marcs; thence to Liverpool at 220 stivers per £1. How much sterling money will he have in bank at Liverpool, and what will be his gain over direct exchange at 10% premium?

£696..11s..2$\frac{182}{407}$D £12..18s..5$\frac{271}{814}$D

4. One-half of a debt of \$2,000 is payable in 10 months, ¼ in 12 months, ⅛ in 16 months, and the remainder in 20 months. When might the whole be paid at one payment? 12⅕ mo

5. A merchant bought 80 yards of cloth 1¾ yds. wide, at \$3.60 a yard; but the cloth having been wet, shrunk 5 % in length and 5 % in width. At what rate per yard must it now be sold to gain 12 % on the outlay? \$4.24$\frac{8}{19}$

6. If 60 cubic inches of lead, together with 54 cubic inches of cork, are equal in weight to 1538⅔ cubic inches of fir, and the weights of equal quantities of lead and fir are represented by the numbers 11·324 and ·45; what number represents the weight of an equal quantity of cork? .24

7. If 40 lbs. of green tea at 60 cents a pound, mixed with 30 lbs. of black at a different price, and the mixture, sold at 80 cents a pound, realized a profit of 22$\frac{2}{9}$ per cent.; what was the price of the black tea? \$.72$\frac{8}{11}$

8. Find the sum of money of which, in the space of four years, the true discount is \$24 greater at 6 per cent. than at 4 per cent. per annum. \$431.52

9. A person invests a certain sum (gold) in U. S. 5's 10-40 which are at 5 % discount, and three times the amount in U. S. 6's 5-20 which are at a premium

\$17733⅓ in gold taking the stocks at 95 & 108 currency respectively.

of 8 %, the interest on both being in gold, and gold at a premium of 8 %; what will these securities cost him if the income from both together is $1134 in currency?

10. A speculator bought a number of sheep for $2150; 25 of them having died he sold $\frac{4}{5}$ of the remainder for $1200, which was $52½ less than cost; how many sheep did he buy? 860

XXII.

1. Reduce to its simplest form:

·0125 divides both terms

$$\frac{(05)^4-(\cdot025)^2(\cdot0125)^2-(\cdot0375)^4}{(\cdot0375)^3-(\cdot05)^2(\cdot0125)-(\cdot025)(\cdot0125)^2}$$

·2375

2. If $\sqrt{2}=1\cdot414218$, find the values of $\frac{1}{\sqrt{2}}$, $\sqrt{50}$, $\frac{5}{2}\sqrt{288}$, $\frac{3}{\sqrt{450}}$. Simplify $\frac{2\sqrt{10}}{3\sqrt{27}}\times\frac{7\sqrt{48}}{5\sqrt{14}}\div\frac{4\sqrt{15}}{15\sqrt{21}}$.

·707106+ ; 7·071065+ ; 42·42639

·1414213

3. A's rate of working is to B's as 7 to 5, B's to C's as 4 to 3, and C's to D's as 5 to 6; A's time of working each day is to B's as 9 to 10, B's to C's as 10 to 11, and C's to D's as 10 to 7; also A's number of days is to B's as 15 to 7, B's to C's as 11 to 20, and C's to D's as 7 to 5. How should $1220, which is paid for the whole work, be divided among them?

A $540
B $200
C $300
D $150

4. Two men start from the same point and run round a ring with different uniform speed; if they run in opposite directions they meet at 72 yds. from the starting point; if they run in the same direction, they are at the starting point together, after one has been seven times round, and the other six times. Find the circumference of the ring. 156 yds

5. A person marks his goods so that he may allow a discount of 4 %, and still make a profit of 15 %.

What must be the marked price of an article that cost him \$1.87$\frac{1}{2}$? \$2.24$\frac{29}{64}$

6. A man is in the habit of walking from his house to take a certain train, in 20 minutes; being one day detained beyond his usual time of starting, he quickens his pace to $\frac{10}{7}$ of his accustomed speed, but is too late by two minutes. How long was he detained beyond his usual time of starting? 8 min

7. The true discount on a sum of money at 7$\frac{1}{7}$ per cent. being \$40, find the true discount on the same sum at 3$\frac{1}{8}$ per cent. for one year. \$ .8$\frac{2}{11}$

8. If 21 bricklayers and 8 carpenters earn \$451.50 in one week, and 6 bricklayers and 4 carpenters earn \$80.50 in 3$\frac{1}{2}$ days, find the daily wages of a bricklayer and a carpenter. \$3.25 & \$ $\frac{7}{8}$

9. What must a person have invested in Consolidated Bank stock at 90$\frac{5}{8}$ paying 8 per cent half yearly dividend, if a transfer of 60 per cent. of his capital to Bank of Commerce stock at 115 paying 4 per cent half dividend would increase his half yearly income \$33.60? \$33350

10. From an official return it appears that there were entered for a certain week at the port of London, oxen, calves, sheep, pigs, and horses as follows: the number of oxen was $\frac{1}{8}$ that of sheep, the number of pigs was 13$\frac{1}{3}$ per cent. of the number of sheep, the pigs were 112 per cent. of the calves, the horses were ~~30~~ per cent. of the whole, and the horses and oxen together were 3587. Find the number of oxen. $\frac{1}{10}$

3570 oxen

XXIII.

1. Simplify $\dfrac{6\frac{2}{3} \text{ of } \frac{3}{10}}{1\frac{5}{7} \text{ of } \frac{1}{2} \div 3\frac{3}{7}} \text{ of } \frac{5}{18} \text{ of } \dfrac{6\frac{1}{9} \text{ of } \frac{9}{22}}{2\frac{7}{9} \text{ of } 2\frac{2}{3}} \text{ of } \dfrac{8\frac{1}{2}}{6\frac{1}{8}}$

$$\div \frac{\dfrac{6\frac{1}{2}+3\frac{1}{3}-\frac{1}{4}}{5\frac{1}{6}+7\frac{1}{12}-\frac{1}{60}} \text{ of } \dfrac{4\frac{1}{7}-2\frac{2}{7}}{6\frac{1}{2}+2\frac{1}{7}}}{\dfrac{\frac{3}{7}+\frac{1}{2}}{\frac{5}{7}-\frac{1}{2}} \text{ of } \frac{25}{988}}.$$

2/7

2. The stocks of three partners, A, B, and C, are $700, $440, and £500, and their gains $224, $176, and $240, respectively; and B's stock was in trade 2 months longer than A's. How long was the money of each in trade? 8, 10, 12 mo respectively

3. What will be the cost of making an excavation 2 dekameters 2 meters 7 dm. long, 2 dekameters 5 dm. 8 cm. wide, and 1 meter 4 dm. 6 cm. deep, at $1.75 per cubic meter? $1190.70 +

4. I can invest $7810 in U. S. 6's 5-20 purchased at 107½ currency, interest payable in gold; or in a mortgage bearing 7 % interest bought at 85; assuming that the premium on gold is 25 %, and that the mortgage is subject to a tax of 1½ %, find the difference in my income by making the more profitable investment.

5. A, B, and C were employed to hoe a field of corn for $25.25. A could hoe a row in $\frac{12}{25}$ of an hour, B in $\frac{8}{15}$ of an hour, and C in $\frac{4}{5}$ of an hour; it so happened that when all first came to the end of a row at the same instant the work was completed. Divide the money fairly among them. $10.10, $9.09, $6.06

6. The true discount on a sum of money for one year at 6% is $2.50 greater than the sum of the true discounts (for the same time) of one-half of it at 8 %, and the rest at 4 %. Find the sum. $7441.20

7. A merchant pays $88 for the insurance of goods at 4⅛ %, and he finds that in case the goods are lost, he will be entitled to receive the value of the goods, the premium of insurance, and \$48.33⅓ besides. What is the value of the goods insured? $ 1997

8. Bought from Thwaite, Eby & Co., Toronto, three kinds of tea at 50 cts., 60 cts., and 70 cts. per lb. respectively; the sum laid out in the first kind was 33⅓ % *less*, and that expended in the third kind 33⅓ % *more* than was expended in the purchase of the second kind. The first was sold at a profit of 20, the second at a profit of 25, and the third at a profit of 30 %, and the entire gain was \$235. Find the amount of each kind purchased. 400 lbs, 500 lbs & 571 3/7 lbs.

9. Shew that the difference of the fractions $\frac{\sqrt{2}-1}{\sqrt{2}+\sqrt{3}}$, $\frac{2\sqrt{2}+\sqrt{3}-1}{\sqrt{3}+1}$, exceeds their product by unity; and find the value of $\frac{\sqrt{1.75}-\sqrt{.63}}{\sqrt{3\cdot5}-\sqrt{2.1}}$. 1.245+

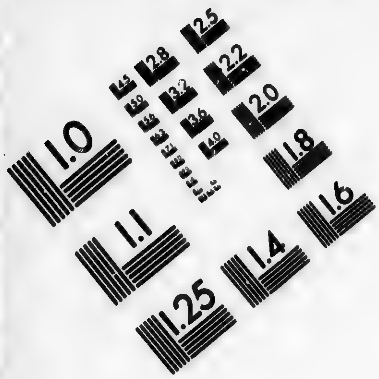
10. A person rows from A to B (1½ miles) and back in an hour; how long would it have taken him if he had rowed equally hard, and there had been a stream of 1½ miles an hour running from A to B for the first 30 minutes, and then ceasing? 55 min

XXIV.

1. If 3 ounces and 160 grains cost 12*l*. 9*s*. 7*d*., and 1 ounce and 80 grains cost 4*l*. 10*s*. 10*d*., how many grains are there in an ounce? 237 1/11 grs

2. One farmer asserts that his and his neighbor's farms are in the proportion of 5 : 2; his neighbor says they are in the proportion of 3 : 1, and the quantity of land thus in dispute is 57⅐ acres. If the actual ratios are 5½ : 2½, find the quantity of land in each farm. 1100 ac, 500 ac

3. An Act of Parliament declares that 277.274 cu. in. of distilled water, at a temperature of 62°F., the



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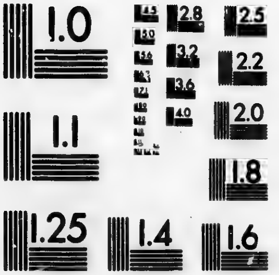

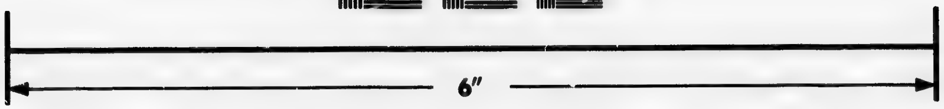

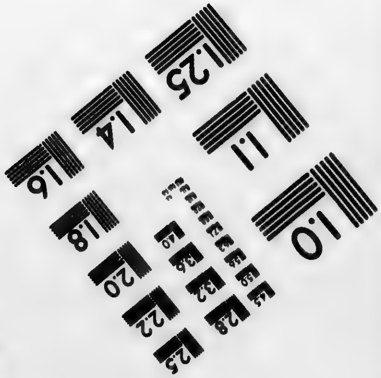

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barometrical pressure being 30 in. of mercury, shall be considered as weighing 10 lbs. Show what fraction is omitted in a lb. when the same Act says that half a grain is the $\frac{1}{505}$ part of a cu. in. of distilled water, and that the lb. avoirdupois is 7000 of these grains. $\frac{2337}{14002337}$ lb

4. A clock is set in motion at 12 o'clock on Saturday night. At noon on Tuesday it is 3 minutes too fast. Supposing it to go at this rate until it strikes 4 on Thursday afternoon, at which time the regulator is altered, so that at noon on Saturday the clock is found to be 5 minutes too late. Continuing the rate what will be the true time when the clock strikes 3 on Monday afternoon? $\frac{549824}{632927}$ hr after 4 on Monday

5. It is proposed to cut a tunnel under the straits of Dover at a cost of 10 million pounds. Suppose the working expenses to be 40 per cent. of the fares, what must be the income to pay 7⅓ per cent. on the cost of the tunnel to the shareholders as promised by the proprietors; what must be the weekly receipts to pay this dividend? £ 1,222,222 2/9

6. Show that the true discount of any sum of money is the present worth of the bank discount for the same time and rate.

If the true discount of a certain sum for 3 years 4 months be 83⅓ per cent. of the simple interest for the same time, and their difference be $24, find the rate per cent. and the sum of money. 6% & $1920

7. If 28 men can excavate 750 cubic yards in 4 days, working 6¾ hours a day, what uniform length of day will 24 men require to excavate 922½ cubic yards in 8½ days, supposing that any 5 of the latter party can do as much in 4 hours as any 6 of the former can do in

8½ hours, and that 2 men will be withdrawn from the latter party after 2½ days' work. 10 4/5 hrs a day

8. A, B, and C, start at the same time to plough a piece of land; B works every day ⅙ longer than A, and C works $\frac{1}{12}$ longer than B; B can do in a given time ⅚ of what A can do, and C ⅘ of what B can do. In what time from the commencement will each have finished an integral number of acres at the same time, supposing that A can plough 7 acres in 4 days? 61 5/7 days

9. A person in Chicago directs a New York broker to buy $5000 U. S. 6's 5–20 at 7% premium. How much must he pay for a draft on N. Y. to cover the purchase, exchange being ¼ per cent., and the broker's commission ¼ per cent.? $5375.90+

10. If $3 be allowed as 9 months' discount off a bill of $53, and at the same rate $8 be allowed off $88, for how long was the latter sum discounted? true disct 15 ms.

XXV.

Edgar Frisby, M. A., Naval Observatory, Washington.

1. I bought a horse for $150 cash and sold him for $160 taking a note payable in 8 months. How much per cent. did I gain by the transaction, money being worth 6 per cent. interest. $2\frac{22}{39}$ %

2. A person engages to do a certain piece of work for $1 per day, but for the first half of the work he is able to earn only 90c. per day, and thinking it an equitable arrangement, he agrees to take $1.10 for the remaining half, but finds that he has lost $1 by this arrangement. How many days did he work and what should he have received daily for the latter half of the work? provided he finishes the work in the expected time

90 days $1.12½

3. I remitted $3999·975 to a banker to invest in stocks; 6 per cents being quoted at 105, and 5 per cents. at 98. I desire to have 3 times as many 5 per cents as sixes. How many of each did he buy allowing ¼ per cent. for his commission? $2999.98 1/8 & $999.99 3/8

4. A bankrupt has liabilities to the amount of $1500 and his assets are $460 cash, one note of $200 payable in 6 months, and one note of a $100 payable in 8 months. How much will he be able to pay his creditors, the bank discounting his notes at 6 per cent. per

$.50 on the dollar No days of grace

5. The difference between the true and the bank discount of a note, payable in one year after date, is $1. What is the face of the note, 10 per cent. discount being allowed and no days of grace? $110

6. A and B together can do a piece of work in 8 days; at the end of 5 days A is taken sick and C is taken in his place, and B and C working together finish it in 2½ days; but if A had continued well, the three working together could have completed it in 2 days. How long would it take each separately to perform it?

A. 26 2/3 days, B 11 3/7 days, C 16 days

7. Two trains whose lengths are 210 and 230 feet respectively, when moving in the same direction pass each other in 15 seconds, and when moving in opposite directions in 3¾ seconds. Find the velocity of each train in miles per hour. 30 & 50 mls per hr

8. A and B are partners in business and have amounts invested which are in the ratio of 3 to 5. They take in a third partner C, who pays them $8000 in such a way that all 3 may receive equal shares of the profits. How much of this money will A and B individually receive, and what was the value of their stock?

A receives $1000 A's stock = $9000
B " $7000 B's " = $15000

9. The population of a town at the end of any year is found by substracting 15 times the population of the previous year from 14 times that of the succeeding year. Two years ago it was 1960, this year it is 2250; show that it increased in Geometrical progression; find the ratio and the population last year.

10. A vessel is worth $4000; for what amount must the owner insure her, so that if she be lost, he will receive back the value of the vessel and the amount paid for insurance, the policy costing 1¼ per cent? $4050.63+

XXVI.

J. H. Johnston, M.A.—Thorold High School.

1. An agent sells goods on a commission of 3%, and invests in certain goods on a commission of 2%, deducting his whole commission before investing, and calculating the 2% commission on the amount remaining after deducting his first commission; the amount invested was $1901.20. Find the amount of his commission. $98.80

2. The sum of $45 paid as premium of insurance at ⅝% entitles the owner, in case of loss, to be paid the value of the property, the premium, and $10 besides. Find the value of the property. $7145

3. A sells goods which cost $278 to B; and B sells them to C, who disposes of them for $364.99½. At what prices did A and B sell the goods, each of the three having made the same rate per cent. of profit? $304.41 $333.33

4. A and B can together do a piece of work in 7 days of 9 hours each; A and C in 6 days of 11 hours each; and B and C in 8 days of 10½ hours each. In how many days of 12 hours can each of them perform the work? A 8 $\frac{38}{53}$ B 13⅕ C 14 $\frac{28}{31}$

5. A note for £1000. drawn February 16th at 11

months, is discounted September 12th at 5½% Bank discount, and the proceeds invested in the 4 per cents, which are at a discount of 12. Find the annual income from the investment. £ s D 44 " 11 " 5+

6. If, on a certain day, the time from noon till sunset was ⅘ as much again as that from sunset till midnight; find the hour of sunrise and the length of the night. 4.17 $\frac{1}{7}$ o'clock + 8 hrs 34 $\frac{2}{7}$ min

7. There are three qualities of cloth; 5 yards of the first quality cost as much as 9 yards of the second, and 9 of the second as much as 11 of the third; also 3 yards, one of each quality, cost $5·97. Find the price of each per yard. $2.97 ; $1.65 ; $1.35

8. A merchant annually increases his capital by 25% of itself, except an expenditure of $1000 a year, and at the end of 5 years finds he is worth $16,207.06¼. Find his capital at first.

9. In what quantities must teas at 60 cents, 72 cents, 96 cents, and $1.08 per pound respectively, be mixed to obtain 174 pounds worth 84 cents per pound? 43½ of each

10. The three sides of a triangle are 33, 56, and 65; find (1) the area of the triangle cut off by joining the points of bisection of the two greater sides; (2) the length of the perpendicular drawn from the greatest angle to the opposite side. (1) 231 (2) 28 $\frac{28}{65}$

XXVII.

Wm. O'Connor, M. A.—London High School.

1. Prove the rule for finding the G. C. M. of two numbers.

Seven bell ringers, A, B, C, D, E, F, and G, begin together to ring seven bells. A rings twice in 1 second, B 4 times in 3 seconds, C 6 times in 5 seconds, D 8 times in 7 seconds, E 10 times in 9 seconds, F 12 times in 11 seconds, G 14 times in 13 seconds. How many seconds will elapse before 4 bells ring together? 22½ sec

2. A surveyor, travelling towards the east along a common road parallel to a railway, observes that it is noon by his watch when a train begins to pass out of the west end of a tunnel. At 12.04 p.m. the traveller meets the train, which takes 10 seconds to pass him. At 12.09 p.m. he is overtaken by another train, which takes one minute to pass him, and which reaches the tunnel at 12.11 p.m., finally the traveller reaches the tunnel at 12.12 p.m., having travelled 2 miles from the point where he made his first observation. Where did the trains pass each other, and how long did they take to do so? 1 4/7 mls from tunnel; 2/7 min

Find
(1) Rate of man
(2) Rate of 1st train
(3) Do. of 2nd "
(4) Length of 1st train
(5) Length of 2nd train.

3. A Toronto grocer imported 50,000 lbs. of sugar from New York, paying freight $166.66⅔ American currency, and Canadian import duty of 1 cent per lb. and 25 per cent. ad valorem. He sold it for $4427.50 Canadian currency, gaining 10 per cent. on his outlay. Find cost of sugar per lb. at New York. Gold at 111 1/9 Ans 6¢

4. A crew which row over a course twice against the stream and once with it in 37½ minutes, can row over the same stream, once against the stream and twice with it in 30 minutes. Compare the rates of the stream and the boat. Crew's : stream's :: 3 : 1

5. A grocer who sells 7 lbs. of butter for the price which he pays for 8 determines to cheat, both in buying and selling, by means of a false balance, 13lbs. in one scale balancing 14 lbs. in the other. By his dishonesty he increases his profit by $29 on a quantity of butter. What does he pay for that quantity? $158.82+

6. A mortgage on a farm is payable in four equal annual instalments of $1000 each. When the first instalment falls due the mortgagor offers in part payment $2000 in 6 per cent. municipal debentures upon which interest is due, and which mature in one year. What balance in cash should the mortgag~~er~~ee demand in exchange for the mortgage, money being worth 10 per cent.? $1439.57 $\frac{1032}{1331}$

7. A merchant consigns 5150 bushels of wheat, valued at $1.40 per bushel, to a broker, who sells it at $1.50 per bushel, and invests the proceeds in dry goods. The merchant pays $150 freight, and sells the dry goods at 10 per cent. advance on cost, clearing $875 on the whole transaction. The broker's commission on purchases being 8 per cent. find his commission on sales. $14.04 6/11 or 2/11 %

8. A merchant insures goods at 2 per cent. for a sum sufficient to cover the value of both goods and premium. The goods are destroyed by fire, but the insurance company fails, paying only 75 per cent. of the claim. The merchant receives $782 less than the value of the goods. Find the value of the goods. $3332

9. Exchange being 110, and gold 125, it costs $451 American currency to pay the duty of 20 per cent. on goods imported from England to the United States. Find the value of the goods. £ 369

10. A path 12 feet wide runs symmetrically along each diagonal of a square garden containing one-tenth of an acre. Find the cost of gravelling the path at 5 cents per square yard. $10.844 +

XXVIII.

W. B. HARVEY, ESQ.—COLLINGWOOD HIGH SCHOOL.

1. A horse was sold for $80; but if it had been

Quotations as to Stg. Exch. are not made
the course of exchange is given as $4.85

sold for \$150 the gain would have been $\frac{3}{4}$ of former loss; find the value of the horse. \$120

2. A's money is $\frac{3}{4}$ of B's, but when A has paid away \$4 more than $\frac{2}{3}$ of his, and B had paid away $\frac{7}{10}$ of his, B's money is halt as much again as A's. How much had each at first? A \$60, B \$80

3. A man can row 6 miles down a stream and up again in 2 h. 40 min. His rate of rowing in still water is twice as great as the rate of the stream. Find his rate of rowing. 6 miles per hour

4. A merchant sends \$4440 in cash and pork to his agent with instructions to sell the pork and invest its proceeds and the cash in buying goods. The agent's commission is 5% both for selling and buying, and his whole commission is \$280; find the value of pork sent and goods bought. \$1440 worth o- pork; \$4160 goods

5. A ship's crew had provisions to last 40 days, allowing each man 8 oz. per day. In a battle on the evening of the 5th day 200 men were killed. The captain can now allow each man 12 oz. per day for the rest of the time; find original number of men. 600 men

6. A trader spent the first year \$40 of the capital and added to his capital $\frac{1}{4}$ of what he had left; the second year he spent \$50 and added to his capital $\frac{1}{5}$ of what he had left; the 3rd year he spent \$60 and added to his capital $\frac{1}{6}$ of what he had left; he finds that his capital is now $1\frac{7}{32}$ of what it was at first; find the original capital. \$960

7. A owes B \$2090 payable in 6 months, and \$3180 in 8 months. He proposes to pay both debts by giving a new note at 4 months. What is the exact sum for which the note should be drawn, so that when B gets it discounted at the bank he may realize what A owes

in the U. S. with reference to the old par \$4.86, &c as the case may be.

him, money being worth 9%, and days of grace not allowed? $5154 62/97

8. A owes B $1020, due in 4 months, and $2080 due in 8 months. B agrees to accept one note for both debts, the time to be fixed by the rule *for equation of payment*. How much does B really lose by accepting the note at 6% $.24 +

9. A barters tea with B for flour worth $8.70 per barrel; but uses a 14½ oz. weight instead of a pound. What price should B ask for his flour to be even with him? $9.60

10. There is a rectangular garden plot whose length is to its breadth as 4 : 3. Around it is a walk 8 ft. wide, which contains 1696 sq. ft.; find the dimensions of the field. 38 4/7 ft by 51 3/7 ft walk being outside

XXIX.

D. A. MAXWELL, ESQ., STRATHROY HIGH SCHOOL.

1. If when 10 gallons of water are added to a mixture of 70 gallons of wine and water, the wine is reduced to 35 % of the mixture; find the proportions of wine and water in the original mixture. wine : water :: 2:3

2. What amount of draft payable in 70 days can be bought for $1008, interest being 6 % and exchange 2 % premium? $1000

3. A owes B $800 payable in 6 months, but in 2 months he pays B $1000 receiving B's note for the balance. When ought the note to begin to bear interest ~~be dated~~? 20 mo before end of 6 mo be made payable

4. A boatman can row with the current from A to B, a distance of 44 miles, in 4 hours; when the current is ⅔ as strong, it takes him 11 hours to row from B to A. What was the rate of the current? 4 1/5 mls per hr

5. For what sum must a note bearing interest at 10 % per annum for 8 months 27 days be drawn that if immediately discounted at a bank at 12 % per annum, the proceeds may pay the premium at 2 % on a policy which covers both the value of a quantity of goods insured and the premium paid, the goods being valued at \$9800? \$201.61 /

6. Tea worth 60c per lb. is mixed with some worth 75c. per lb., and the mixture sold for 76c. per lb., gaining 10 % on the price of the first and 12 % on the price of the second. In what proportions were they mixed? 4 @ 60c 5 @ 75c

7. A capitalist holding R. R. Bonds to the amount of \$20000 disposed of them at $96\frac{1}{8}$ for Capital Stock in a Bank at $79\frac{7}{8}$, brokerage $\frac{1}{8}$ % in each case. The Bonds drew 10 % annually int. payable in currency; the Bank Stock paid $3\frac{1}{2}$ % the first half-year and $4\frac{1}{2}$ % the second half-year, the dividend in both cases being payable in gold which is at 120. Upon the receipt of the first half-year's dividend it was invested for 6 months at 8 % per annum on its currency value; what difference is made in currency in the yearly income by the transactions? \$344.32

8. A merchant in Montreal wishes to pay £50000 in London. Exchange on London is $9\frac{1}{2}$ % premium, on Paris 5 francs 60 centimes per \$1, and on Amsterdam 45c. per guilder; between Amsterdam and London $12\frac{1}{2}$ guilders to £1, between Paris and London 25 francs to £1. Which is the most advantageous, the direct exchange or through Amsterdam or through Paris, and by how much in each case? Direct \$243333⅓; By Paris \$223214.28 By Amsterdam \$281250

9. An express train left Suspension Bridge for Windsor at 12 P.M. at the rate of 40 miles per hour including stoppages, except that at London of 80 minutes. A special train left the Bridge at 1-51 P. M. and

arrived in London 45 minutes after the express had left; after a delay of 10 minutes it proceeded with an increased speed of 10 miles per hour. When the express due in Windsor in 34 minutes, passed Belle River Station, the special was at Stony Point. The distance from Windsor to Stony Point is 26 miles, and from Suspension Bridge to London 120 miles. If the speed of all trains from Belle River to Windsor is limited to 30 miles an hour, how far is it from Supension Bridge to Windsor? 229 mls

10. A contractor was to receive a certain price for a a piece of work. If he employed a certain company of boys he would have to give them ⅓ of the contract price; but if he employed a certain company of men, he would have to give them ⅔ of the contract price. To facilitate the work, he employed both companies and he received $2000 less than he would have received if he had employed the boys only. Find the contract price.

XXX.

James Bruce, Esq.—Waterdown High School.

1. Divide $3000 among A, B, C, and D, giving A $40 more than ⅓ of the other three taken together, and B $50 less than 60 % of what C and D receive, and C $30 more than 40 % of D's share. 780; 801 1/4; 926 11/14; 191 27/28

2. Two trains start at the same time, one from Hamilton to Toronto, the other from Toronto to Hamilton, both travelling uniformly. If they arrive in Toronto and Hamilton respectively in 2¼ hrs. and 4 hrs. after they passed each other, compare their rates of travelling. 3:4

3. If I place a cent piece which is one inch in diameter on a map of one of the townships of Canada, and

it covers 502 ac. 3 r. 17 per. 4 yds. 2 ft. 128¾ in.; find the scale on which the map is drawn. 1 mil to the inch $\pi = \frac{22}{7}$

4. If a rectangular cistern 6 ft. long, 4 ft. broad, and 8 ft. deep, be made eight times as large without changing the relation of its dimensions; find its length, breadth, and depth, and how many gallons of water it will hold, assuming that a cubic foot of water weighs 1000 oz. Avoir., and that a gallon of water weighs 10 lbs. 12 × 8 × 16 ft 9600 gal

5. If a debt of $4000 due at the end of 4 years, were discharged by four equal annual instalments; find the amount of each instalment, assuming money worth 6 % per annum compound interest. $914·36+

6. Simplify $(12{\cdot}96 + 3\frac{3}{5} \times 8{\cdot}\dot{1} + \frac{7{\cdot}3}{9} \times 8\frac{1}{9})\ (3{\cdot}6 \times 3\frac{3}{5} - \frac{1{\cdot}8}{5} \times \frac{7{\cdot}3}{9} + 65{\cdot}\dot{7}9012345\dot{6}) \div \{12{\cdot}96 \times 12{\cdot}96 + \frac{1{\cdot}8}{5} \times \frac{1{\cdot}8}{5} \times \frac{7{\cdot}3}{9} \times \frac{7{\cdot}3}{9} + (\frac{7{\cdot}3}{9} \times \frac{7{\cdot}3}{9})^2\}$.

7. A merchant bought goods for $30 with 6 months credit, and sold them forthwith at $35, with such an allowance of credit as made his gain 10 %; how long credit did he give, reckoning money worth 5 % per an. simple int.? $20\frac{10}{11}$ mo $1\frac{54}{61}$ yrs = $22\frac{38}{61}$ mo

8. When wheat was $1.10 a bushel a 4 lb. loaf was sold for 12 cents, but when wheat fell to $1.00 a bushel the 4 lb. loaf was sold at 11 cents. Assuming the cost of converting wheat into bread to be 30 cents on every 100 lbs. of bread, and that the baker was clearing 10 % of his receipts at the former price; what percentage of his receipts would he gain or lose at the latter price? $9\frac{91}{121}$ %

191 27/28

9. If the three sides of a triangle be 8 ft., 10 ft., and 12 ft., find the length of the segments into which the greater side is divided by a perpendicular from the opposite angle; also the length of the lines drawn from

the middle of the perpendicular to the angles of the triangle. Segments 4½ ft + 7½ ft ; 8.19 ft ; 3.30+ ft ; 5.57+ ft

10. If an arc of a circle be 2 feet, and the radius of the circle be 6 feet, find how many degrees in the arc. 19 1/11 degrees if $\pi = \frac{22}{7}$

XXXI.

W. J. Robertson, M.A., St. Catharines Coll. Inst.

1. An insurance company takes a risk of $10000 on a church at 1½ %, and reinsures ⅔ of the risk in other companies at 1¼ %. The church is insured at ⅘ of its value, and after the payment of two premiums, is destroyed. Find the loss sustained by the first company and also by the trustees of the church. $3200 ; $2800

2. A certain alloy is composed of gold and silver in the proportion of 2 : 1, the value of the silver per oz. being 1/15 that of the gold. A coin composed of the alloy, and weighing 5 ozs., is worth $51.66⅔. Find the number of ozs. of gold and silver in the coin, and the value of each per oz. Gold $15 ; Silver $1 ; 10/3 oz ; 5/3 oz

3. A certain company employs men at wages varying directly and jointly with the number of hours worked and the skill manifested. Two men, A and B, are employed. A works 10 hours a day, whilst B works 12. B's skill is 20 % less than A's. After working a certain time A finds that he has earned $20 more than B, which is what A would earn in 4 days if he worked as many hours per day as B. Find B's wages and the number of days A and B worked. $4 ; 120 days

4. A tradesman wishes to secure a profit of 10 % on what he manufactures ; ¾ of his sales are on a credit of 6 months. What should the selling price of an article which costs $100 be, the credit and cash

price being the same, and money worth 8 % per annum? $113 $\frac{27}{101}$

5. A treasurer of public funds employs the money entrusted to him in business, and makes a profit on it equivalent to 20 % per annum. At the end of 6 months, being called on to make a payment of $2,000, he discounts a note drawn at 6 months at a bank, paying 10 % for accommodation. At the end of the year he finds he has gained $500. How much money was placed in the treasurer's hands? $3026 6/19

6. A takes a contract on the Welland Canal, and sublets it so as to make 20 % profit. B, the sub-contractor, after finishing $\frac{5}{8}$ of the contract, and receiving pay for the whole of it, abandons the work, and by so doing makes a profit of 25 %. A has to complete the contract at the same proportionate cost as B was put to, and finds that he will clear $5000. How much was A's tender? $150,000

7. A rents a house for 5 years. He is to pay the taxes at 2 cents in the $, make repairs on entering, which will cost 20 % of the value of the house, and pay annually $100. The house is assessed at $\frac{4}{5}$ of its value, and the taxes are $32 per annum. Find the actual rent A pays, money being worth 10 %. $~~240.63~~+ yearly 237.51+

8. A vessel contains a certain number of gallons of wine, 20 % of water is added, and the mixture is found to be too strong; 15 gallons more of water are added, which increases the amount of liquid previously in the vessel by a percentage equal to $\frac{1}{2}$ the number of gallons of wine in the vessel. How much wine in the vessel? 50 gal

9. The population of a city increases 32604 in 3 years. The increase is due to an immigration of persons, 2000, and to the births exceeding the deaths. The

births are $\frac{1}{25}$ of the population, and the deaths $\frac{1}{50}$, annually. Find the population of the city at the end of the period. 532604

10. A field of 1 acre, on a new farm, contains a certain number of stumps. The productivness of the field increases 10 %, when 20 % of the stumps are extracted. 20 % of the stumps are taken out annually, at a cost which diminishes yearly 10 % of the original cost. The field produces 20 bushels of wheat per acre before the stumps are extracted, and wheat sells at $1 per bushel. During time the field is being stumped, the produce exceeds the expense of stumping by $9 Find the number of stumps in the field, if it costs $1 to remove a stump the first year. The stumps are taken out each year before it is sowed -- Ans 50 stumps

XXXII.

Alexander Murray, M.A.—Galt Coll. Inst.

1. Convert into vulgar fractions in their lowest terms, $\cdot\dot{2}\dot{7}$, $\cdot 0\dot{2}\dot{7}$, $\cdot 02\dot{7}$, proving the method employed; also find the G. C. M. of these decimals.

2. A train leaves A at 6·15 A.M. and arrives at B at 11·30 A.M. Another train leaves B at 8 A.M. and arrives at A at 2·45 P.M. When do these trains meet? 9:58 1/8 o'clock

3. A liquor dealer mixes spirits which cost him 80 cents a gallon with another kind which costs 75 cents a gallon, and adds a certain quantity of water. He sells 124 gallons of this mixture for $86.80, thereby making 40 per cent. profit. How many gallons of each kind of spirits and of water were in the mixture? 40, 40, 44

4. A person had $3000 stock in the 3½ per cents which were worth 98, and the same amount of stock in the 6 per cents at 102. He transfers the stock in the

one to the other. Find the change in his income. $2.78 increase

5. A gives B a bill of \$450 due at the end of 6 years in discharge of a bill for \$360 due at the end of 5 years. For what sum should B give A a bill due at the end of 7 years to balance the account, compound interest at 6 % being allowed? \$72.50 2/5

6. I require \$22 more than I have to purchase a certain amount of stock selling at a premium of 9 %; and I have \$60 more than is required to purchase the same amount of stock selling at a discount of 2½ %; How much money have I? \$755 5/23

7. A merchant's selling price is 5 % less than his marked price; 6 % of his sales are bad debts; his profits are 25 % on his outlay. What per cent. above cost is the marked price? $39\frac{873}{893}$ %

50 steps

8. Suppose a clock has three hands moving round the same centre—an hour, a minute, and a second hand. At what time after 12 a.m. will (1) the minute and second hand, (2) all three be first together? 61 1/59 sec. (1)

9. A merchant charges 6 % per annum on all accounts overdue. What ~~reduced~~ reduction on the percentage on the balance of a bill of \$460 paid one month after the bill was due, would be an equivalent to prepayment of \$150 of the bill 2 months before the bill was due? $5\frac{1}{310}$ %

10. Find the value of $\frac{\sqrt{2}}{\sqrt{5}+2}$ by only once extracting a root. The diagonal of a rectangular field is 5 chains 40 links, and one of its sides is three times the length of the other; find the side of a square field of equal area. 2 ch. 95.77+ links

11. The amount of a certain principal in a certain time for a certain rate (simple interest) is \$280; and

the amount of double the same principal at same rate for half the former time is $300. Find the principal. $20

XXXIII.

JAMES BROWN, M. A.—UPPER CANADA COLLEGE.

1. Distinguish between Interest and Discount.

If the discount of a certain sum be $\frac{8}{9}$ of the interest of the same, what is the rate per cent. of the latter? 12½%

2. (1) On March 20th, a merchant sold goods to the value of $1168, and received a note, due June 8th, next, for that sum with interest at 7 % per annum. For what amount was the note drawn? $1185.92

(2) The above note was discounted on the 27th of March; what sum should the discounter advance so as to receive interest at 12 % per annum on his money? $1158.125

3. If $560 be accepted as present payment of a debt $577½ due in five months, what is the rate of interest ℔ cent. ℔ annum? 7½%

4. A person sells $3500 Dominion Bank stock @ 130, and invests the proceeds in stock of the Bank of Toronto at 182. The dividends being respectively @ 8 and 12 per cent., and the brokerage ⅛ per cent. (included in the above prices), find—

(1) The amount of stock purchased. $2500

(2) The alteration in the income. $20

(3) The brokerage on the transactions. $7.50

5. How much money must be invested in Dominion Bank stock, @ 131, to produce an annual income of $1800, after paying an income tax of 1½ cents on the dollar?

6. What is the difference between 8 % per annum

and 2 % per quarter, at Simple Interest and at Compound Interest respectively? None at S.I. ; .243216% at C.I

7. Prove the equivalence of the two quotations of Sterling Exchange, 108 and $4.80.

If Sterling Exchange, in Toronto, be at par, and Exchange on Paris be, in London, 1 franc=9¾*d.*, what will be the equivalent quotation in Toronto of exchange on Paris? 1 franc = 19 $\frac{31}{48}$ cents

8. If Sterling Exchange be @ $4.82 (gold) and gold at 105, in New York, while in Toronto Sterling Exchange is @ 108¾, and U. S. currency @ 95, find how much may be saved on a draft for £1200 by remitting through New York. $30.46

9. A manufacturer who employed men at $1.60 a day found that he could save 15 % by employing women; what wages were paid the latter, supposing a man could do one-third more than a woman in the same time? $1.02

10. A school is divided into three classes, of which the second contained one-fourth of the whole school, but 12 new pupils having been admitted into the third class, and 15 promoted from the third to the second, and 6 from the second to the first, the classes are now equal; how many pupils are there? 72 pupils

XXXIV.

THOMAS CARSCADDEN, B.A.—RICHMOND HILL HIGH SCHOOL.

1. Define an abstract number, a concrete number. What is the difference between 85*s* divided by 17 and 85*s*. divided by 17*s*.?

2. The net rental of an estate after deducting 9*d*. in

the pound for Income tax, and 1*s.* in the pound of the remainder for poor rates is £877 16*s.*; find the gross rental. £960

3. The difference between the interest of a certain sum for 1 year and the discount on the same sum due a year hence at 5 per cent. per annum is 75 cents; find the sum. $315

4. Show from first principles how to multiply one fraction by another.

Find the value of

$$\frac{\dfrac{3\frac{1}{2} \text{ of } 1\frac{1}{4}}{1\frac{5}{6} \text{ of } 3\frac{3}{4}} \div \dfrac{1\frac{3}{5} \text{ of } 2\frac{1}{4}}{1\frac{1}{10} \text{ of } 2\frac{1}{7}}}{\left(\dfrac{2\frac{1}{4} - \frac{2}{3} \text{ of } 1\frac{5}{6}}{\frac{1}{5} \text{ of } 3\frac{1}{3} + \frac{13}{36}} - \dfrac{1}{2\frac{1}{2}}\right) \div \dfrac{1}{1\frac{2}{3}}} \text{ of } \$32{\cdot}76 \text{ cents.}$$

5. If 9 men or 12 boys can do $\frac{3}{8}$ of a piece of work in 3¾ hours, in what time will ten men and 15 boys do the rest? 2 $\frac{11}{17}$ hrs

6. Show how to change a vulgar fraction into a decimal, and prove that the decimal will terminate or recur according to the form of the denominator of the given fraction in its lowest terms.

What kind of a decimal will $\frac{37}{42}$ produce?

7. A merchant buys goods; the cost of freight is 8 per cent., and that of insurance 12 per cent. on the original outlay; he is obliged to sell them at a loss of 7 per cent.; but if he had received £20 8*s.* more for them he would have gained 1¼ per cent. Find the original outlay. £200

8. A person rowed a distance of 8 miles down a stream in 45 minutes, but without the aid of the stream it would have taken him one hour; what is the rate of the stream per hour and how long would it take him to return against it? 1 mil per hr; 1½ hrs

9. A merchant buys coffee at the rate of £8 16*s.* per cwt., and chicory at £1 8*s.* $6\frac{6}{7}$*d.* per cwt., and mixes them in the proportion of 10 lbs. of coffee to 7 of chicory; at what rate must he sell the mixture so as to gain $4\frac{4}{49}$ per cent.? £. 6 per cwt

10. Explain the method of pointing in extracting the sq. root of a whole number, and also of a decimal.

(*a*) If the surface of a cube is 39 sq. ft., find the length of its edge. 30.594 + inches

(*b*) Given that the square of 18725=188375625; find the square of 187254 without going through the operation of squaring. 18838660516

XXXV.

JOHN J. MAGEE, B.A.—UXBRIDGE HIGH SCHOOL.

1. Simplify $\dfrac{4\frac{1}{2}-3\frac{1}{3}+5\frac{1}{12}}{7\frac{1}{2}-4\frac{1}{3}+11\frac{1}{12}}-\dfrac{11\frac{3}{4}-5\frac{7}{15}}{11\frac{3}{4}+5\frac{7}{15}}$.

2. What will be the area of the part remaining of a circle whose diameter is 24 inches, after the largest possible rectangle has been cut out of it. 164.3904 [illegible] $\pi = 3.1416$

3. A has $45000 5 % Dominion Stock, and is offered by the Government the choice of being paid off at par, or of receiving $110 G. T. R. stock paying 2½ % dividends for each $100. He choses the former, and invests his money in Bank Stock at 92 paying 3 % dividends. Find the excess of his income over what it would have been had he accepted the G. T. R. stock. $ 229.89 3/23

4. A merchant sells 50 yds. of broadcloth at a gain of 15 %, and 75 yds., which cost the same per yard, at a gain of 10 %, and finds that if he had sold the whole at a uniform gain of 12½ %, he would have received

$2.26 $\frac{9}{16}$ more than he actually did receive; what was the cost price per yard? $ 3.62 ½

5. Having 2½ hours at my disposal, how far may I ride at 10 miles an hour, that I may return in time, walking at the rate of 4 miles an hour. 7 1/7 mls

6. A man engages to work for 56 days at $1.37½ a day, but he had to pay 25 cents a day for every day he was idle; at the end of the time he received $51; for how many idle days did he pay? 16 days

7. If the credit price of an article be $36.00, and the ready money price be $34.20, mercantile discount being allowed, what must be the credit price, that while charging the same ready money price twice the rate of discount may be allowed? $ 38

8. If 3 men and 4 boys work 6 days for $44.10, and 4 men and 5 boys work 8 days for $76, how long ought 6 men and 7 boys to work for $165.60? 12 days

9. The breadth of a room is 16 feet; the cost of papering the walls at 24 cents a sq. yd. is $20.16, and of carpeting the floor at $1.25 per sq. yd. is $44.44 $\frac{4}{9}$. Find the height and length of the room. 10 ½ ft; 20 ft

10. A cask containing 126½ gallons is bought for $208.33⅓, and kept for four years, during which time 1½ quarts evaporate yearly. What do I gain per cent. by selling the remainder at $2.50 per gallon, the 4½ consols being at 90?

XXXVI.

Rev. George Grant, B.A.—Simcoe High School.

1. A storekeeper buys six boxes of goods, two being damaged sold at 5% loss; but selling the whole for $550, he gains 10% on the whole cost. Find his gain % on the good boxes? 17½ %

2. A merchant has teas at 80, 60 and 40 cents per lb. respectively. He wishes to make a mixture amounting to 1089 lbs., so that selling at 70 cents per lb. he may gain 10%, and at the same time give one-half oz. on every lb. to his customers to turn the scale. How many lbs. of each kind must he use? 425 at 80, 332 of each of others

3. A party numbering 120, made up of men, women, and children propose to go on an excursion. It is agreed that each man, woman, and child pay in the ratio of 3:2:1. The total outlay is $500. In consequence of the failure of 4 men, 5 women, and 6 children to join the party, the aggregate of the men's shares is to that of the women's and children's shares respectively as 5:6:7. Find the number of women that went with the party. 27 women

4. An excise duty of 90 cents per hogshead is levied on crude petroleum. The producer realizes 20% on his sale. The refiner after allowing for a shrinkage of 20% in the process of refining, makes a profit of 25% on his outlay. In like manner the wholesale dealer and retail merchant each clear 12% on their outlay. If the tax were abolished, what reduction in price per gallon on the refined oil could be made to the consumer, supposing each dealer to make the same rate of profit as before? $.0336

5. If stock bought at 5% premium pay 6% on the investment, what per cent. will the broker make who buys the same stock stock at 10 discount, and after drawing the dividend sells out for 105 American currency, gold being worth 105? 18 1/9 %

6. Three circular flower-beds, each bounded by a line 355 inches in length, are situated so that their circumferences are in contact. Find the area of the triangular space lying between and not included within the flower beds. $\pi = \frac{355}{113}$

514.764+ sq in

7. The directors of a joint stock company reserve $1000 of their capital for current expenses, and in the first year increase the remainder by $\frac{1}{5}$ of itself. The same operation is repeated in each succeeding year, until at the end of the fifth year the company is worth $20,000. What was the capital at first? $15904.90

8. A farm is sold for $2500. The purchaser pays $\frac{1}{5}$ down and gives a mortgage for the balance, principal and compound interest at 8 per cent. per annum payable at the end of 5 years. The mortgagee immediately barters the mortgage for a fixed sum, to be paid in four equal payments, one at the end of each year. If money be worth 10% per annum, what should be the amount of the annual payment? $575.63+

9. The price of a loaf is 10 cents, when the outlay for flour is 60%, the cost of delivering 10%, and other incidental expenses 20% of a baker's receipts. The price of flour falls 20%, and the cost of delivery rises 20%, what should be the price of the loaf so that the baker may still make the same rate of profit as before? $,08 5/9

9. If $20 be the discount off a bill of $200 due some time hence, what would be the discount off:—(A) If the bill had twice as long to run, and at double the rate of interest. (B) If it had half the time to run, and at half the rate of interest? (1) $61.53+ (2) $5.40+

XXXVII.

J. DEARNESS, ESQ.—PUBLIC SCHOOL INSP., MIDDLESEX.

1. What part of $1\frac{4}{5}$ of $\frac{1}{2}$ of $7\frac{2}{9}$ of 5 pints of wheat is $8\frac{1}{4}$ oz. of the same grain?

2. A grocer's scales weigh light by $\frac{1}{4}$ oz. per lb. He sells for cash at an advance of 20 per cent. on invoice

rates, on which by paying cash he receives a discount of 5 per cent. What is his exact gain per cent. on goods he weighs out?

3. A goldsmith pays $\frac{1}{2}$ as much per oz. Avoir. as he sells for per oz Troy. What is his exact gain per cent?

4. Clock No. 1 loses ·05 per cent; the rate of clock No. 2 is one hundred and one per cent. of the rate of No. 1. They are set right, and on Saturday at 9 p. m. No. 2 is $56\frac{97}{100}$ minutes fast. When were they correct?

5. In a field in which cows and sheep were grazing, $\frac{1}{7}$ of the total number were cows; but when 3 cows more were driven in, the later numbered $\frac{2}{11}$ of the whole. How many sheep were there?

6. The true discount for one year is to the bank discount for one year as $\frac{100}{7}$ to $\frac{121}{8}$. Find the rate per cent. (360 days=1 yr.)

7. The total assessed value of a certain township is $2,300,000; that of a separate school section within it is $115,000. The county levied for public school purposes on said township $920; which by mistake was collected off the whole township. How much should be refunded said separate school section?

8. Three lbs. of coffee and 2 lbs. of tea cost $3.00; an increase of 10 per cent. on the former, and a decrease of 10 per cent. on the latter reduced the bill six cents. Find the original price of each per lb.

9. How should a man divide $10,788.12½ between his two sons, aged respectively 15 and 18 years, so that each on attaining his majority may receive an equal sum, providing that the money at time of division be deposited at 5 per cent. compound interest?

10. The distance between the centres of a fore wheel

✓ / and hind one of a buggy is 4 ft. 6 in.; between the nearest points of the circumferences of the same, 6 in.; the hind wheel is 4 in. higher than the fore one. Given that 44 radii are equal 7 circumferences, find what distance has been moved over when the fore wheel has made exactly 100 revolutions more than the hind one. 2 mls, 4499 11/21 ft

XXXVIII.

G. K. Powell, P. S., Toronto.

✓ 2 1. A man bought goods for $750, and sold a certain portion of them at a loss of 4 %. Having increased his selling price 12½ % he gained 4 % on the whole transaction. Find the portion of goods sold at a loss. 1/3

✓ 3 2. Two farmers, A and B, together sold 500 sheep, A at $7.25 and B at $7.75. They received altogether $13 more than they would have done had they both sold at the uniform rate of $7.50 a head. Find the number sold by each. A 224 B 276

3. A merchant in Ottawa buys sugar in New York at 7 cts. currency per lb., pays an ad valorem duty of 20 % and a specific duty of 2 cts. per lb. Exchange is ⅛ % premium and gold 112. At what price must the sugar be sold to yield a profit of 25 %? (Duties paid in gold.)

✓ 4 4. Find the market value of 5 % bank stock, so that after paying an income tax of 4*d.* in the £ it may yield 6 % interest. 81 17/18

✓ 5 5. A merchant buys a quantity of syrup for $1512. By the use of a false measure and by marking his goods at a profit of 20 %, his gain is $604.80. Find the size of his gallon. 3 3/7 qts

6. In a German college the professors number 18.2

% of the whole; on the admission of 50 more students the professors then number but 12 % of the whole. Find the number of professors.

7. What price must I pay for Montreal Bank stock, three months before the dividend is due, in order to make 9 % on my money, the bank paying half-yearly dividends of 8 %? 181.689

8. The cost of carpeting a room whose breadth is two-thirds of its length is £10 14*s.*, the carpet being 27 inches wide, and worth 6*s.* 6*d.* per yd. Find the length of the room.

9. The true discount on a note of $945, drawn at 9 months, is $70. Find the rate per cent.?

10. (*a*) The sides of a right-angled triangle containing the right angle are 12 and 5. Find the length of the straight line joining the right angle with the middle point of the hypothenuse.

(*b*) The sides of a triangle are 20 and 30, and the base 35. Find the perpendicular on the base from the opposite angle and the segments into which it divides the base.

XXXIX.

I. G. BIRCHARD, ESQ., P. S., TORONTO.

1. Explain the principles employed in finding the G. C. M. and L. C. M. of numbers, and illustrate by applying them to the solution of the following examples:

Find the G. C. M. of 2527, 1813, 2730. Find the L. C. M. of 15, 16, 20, 25, 27, 30, 35.

How would you proceed if any of the numbers were fractional?

2. Simplify $\frac{1+(\cdot\dot{1}4285\dot{7})^2+(\cdot\dot{1}4285\dot{7})^4}{1+(\cdot\dot{1}4285\dot{7})+(\cdot\dot{1}4285\dot{7})^2}$, and find the value of the following to five places of decimals:

$$1+\frac{1}{1}+\frac{1}{1\times2}+\frac{1}{1\times2\times3}+\frac{1}{1\times2\times3\times4}+\text{\&c.}$$ 2·71828

3. Shew that every fraction can be exactly expressed either as a finite or a circulating decimal. How can we determine without trial whether a given fraction when reduced to a decimal will give a finite decimal, a pure circulating decimal, or a mixed circulating decimal? Illustrate by examples.

4. A merchant bought 1295 yards of cloth and marked it at an advance of 20% on the cost price; in selling the first half of it he gave only 35 inches for a yard, and 37 inches for a yard in selling the remainder. He gained $260.20; what did the cloth cost him?

5. A and B run a race, B has a start of 20 yards, and takes 12 steps while A takes 11; but 10 of A's steps are equal to 11 of B's; how far will B run before A catches him?

6. A note for $1976, bearing interest at 6%, has run 146 days; what must be the face of a new note which, discounted by the bank for 73 days, at 6%, will just redeem the former?

7. A stock broker has $1500 more than $\frac{5}{11}$ of his money in Montreal Bank stock, and the remainder, which is $2500 less than $\frac{7}{12}$ in Toronto Bank stock; the former pays 7% half-yearly and the latter 10% yearly. Find his net income after paying an income tax of $1\frac{1}{3}$ cents on the dollar.

8. A merchant sends flour to his agent in Toronto, who sells it at $6 per bbl., and deducts his commission

at 2% ; he then reinvests the balance in goods, deducting his commission at 2% ; his whole commission was $\$23\frac{9}{17}$. How many bbls. were sent?

9. There were 6464632 letters posted at the Toronto Post office in 1876 ; if the average size of each were 3 in. by 5 in., how many miles of King street, 66 feet wide, would they cover?

10. A well 30 feet deep and 6 feet in diameter is curbed with a wall of loose stone $1\frac{1}{2}$ feet thick.

(1) How many cords of stone are in the wall?

(2) How many tons of water would it hold if the interstices between the stones occupy $\frac{1}{4}$ of the volume of the wall.

XL.

G. B. Sparling, B. A., Upper Canada College.

1. Find the difference between

$$\left\{\frac{\dfrac{7\frac{1}{3}-2\frac{3}{4}\text{ of }2\frac{2}{11}}{5\frac{3}{4}-\frac{3}{4}(3\frac{1}{2}-\frac{1}{3})}}{\dfrac{2\cdot6\text{ of }2\cdot\dot{2}\dot{7}}{1\cdot1\dot{3}\dot{6}}}\right\}\text{ of £3 18}s.,$$

and $\dfrac{5\frac{5}{8}\div3\frac{3}{4}+2.08\dot{3}}{124(\cdot05\text{ of }\cdot\dot{3}\text{ of }4)-1\div(\frac{1}{2}+\frac{1}{3})}$ of $1\frac{1}{2}$ guineas.

2. Two pipes, A and B, fill a cistern in 16 and 20 minutes, respectively, and C empties it in 6 minutes. Suppose the cistern to be empty at first. After A has been open 4 minutes, B is opened, and after 4 minutes more C and D are opened, and the cistern is emptied in 56 minutes. In what time would D empty it if full.

3. How many boys must assist 27 men in order to earn $304.85 in 13 days, if 7 men and 5 boys earn

$49.05 in 9 days, and 2 men and 19 boys in 11 days earn $65.45?

4. What principal, lent out at 5% Compound Interest for 3 years, will produce the same amount as $2222.64, lent out at 6% Simple Interest for 4 years 2 months?

5. A person invests the proceeds of a note for $9607.50, due 18 months hence, discounted (true discount) at 4½%, in 6% stocks at 91, paying brokerage ¼%. Find his net annual income from this investment after deducting an income tax of 2½ per cent.

6. A garrison is provisioned for 180 days; at the end of 30 days it is found that 25% of the stores then remaining are unfit for use; at the end of 30 days more it is reinforced by 2000 men, and then the stores are made to last 110 days longer by putting the men on half rations. Find the number of the original garrison.

A, B, and C engage in business. A puts in $400 at first, and $400 more at the end of 6 months; B puts in $900 at first, and withdraws one-third of his capital at the end of 6 months; C puts in $200 at the end of every 6 months; at the end of two years they have gained $6700. What share of the profits should C receive in addition to 25% of the total profit for managing the business?

8. If there be melted together 80 oz. of copper, of specific gravity 8·7, 10 oz. of tin, of specific gravity 7·4, and 4 oz. of lead, of specific gravity 11·4; find the specific gravity of the resulting bronze, allowing for contraction in the ratio of 100 : 99.

9. A grocer mixed green tea which cost him 28 cts. per pound with black tea which cost 42 cts., and by sell-

ing the mixture at 35 cents he gained 15% on the green tea and 20% on the black. In what ratio were the teas mixed ?

10. I sold goods which cost me $4000 so as to gain $11\frac{1}{9}$% of the *proceeds*, and a second lot which cost me $5000 so as to gain $28\frac{4}{7}$% of the *proceeds*. Find my gain % on the entire outlay.

11. (1) If the parallel sides of a garden be $65\frac{1}{2}$ ft. and $49\frac{1}{4}$ ft. respectively, and their perpendicular distance $56\frac{3}{4}$ ft., what did it cost at $1627.50 per acre ?

(2) It is required to cut off from a triangular field whose sides are 1200, 1000 and 800 links respectively, 1 acre, 2 roods, 16 perches, the dividing line being parallel to the longest side. Find the sides of the triangular part cut off.

XLI.

J. W. CONNOR, M.A., HIGH SCHOOL, BERLIN.

1. Divide 8873 by 15, using factors, and explaining without reference to fractions the method of finding the complete remainder.

What would be the remainder if the divisor were $3 \times 5 \times 7$?

2. In Babylonia a capithe of meal was sold for 4 sigli. A siglus was worth $7\frac{1}{2}$ obols, the capithe held 3 qts. Find the price of meal per bushel, taking the obol at $3\frac{1}{2}$c.

3. Assuming only the fundamental definitions, prove that multiplying both terms of a fraction by the same number does not alter its value. Show clearly what operations depend on this property.

4. Reduce $\frac{6}{79}$, $\frac{4}{59}$, $\frac{8}{99}$, to a common numerator, and hence find which is greatest and which is least.

5. Divide to five decimal places 2·6378 tons by 256·135 tons. State the denomination of the quotient, and express the remainder in lbs. and oz.

6. A lump of gold 22 carats fine contains 27 oz. of alloy, how many oz. of alloy in a lump of the same weight only 18 carats fine?

7. A bankrupt's estate was expected to pay only 48 cents on the dollar; but a claim of $1000 being disallowed, it paid 60 cents instead; find its value, the costs amounting to 20 % thereof.

8. A and B become partners, and invest $15000 and $20000 respectively, B to get 8 % per annum interest on the excess of his capital over A's, A being paid $800 a year for his time, balance of profits to be shared equally. At the year's end A has drawn $600 on account, and the net value of the business is $37200; how much of this belongs to each partner?

9. How much better or worse is it to buy 6 per cents at par with $20,000, and also with the half-yearly dividend thereon, selling at par at the end of the year, than to use the money in discounting 70 day notes at 6 % per annum, the money being employed the whole time?

10. A buys a lot for $300, agreeing to pay every year $75, with interest thereon at 6 % from the date of the purchase. At the end of two years he sells it for $400 to B, who assumes the two payments yet to be made, and pays cash for the balance. Supposing that every year interest was paid on the whole sum due on the lot, out of how much was B cheated, money being worth 8 %?

11. A man in England wishes to buy as much 6 per cents municipal debentures as will give his daughter

resident in Canada an income of $794 per annum over and above income tax at 1½ cents in the dollar, $400 of every one's income being exempt from taxation. Debentures selling in Montreal at 95¾, brokerage ¼, and sterling exchange being there at 8 % premium, what sum in sterling money must he lay out?

XLII.

C. A. Barnes, Esq.—Strathroy, P. S.

1. A man bought 360 bushels of wheat at a certain price per bushel and sold ½ of it at a gain of 10 %, ¼ at a loss of 25 %, and the remainder at a gain of 45 %, and by so doing realized $594 for the whole lot. What was the cost price per bushel?

2. A's farm contains 5 acres as often as B's contains 8, and C's farm lies between them. Now if C should give up ⅗ of his farm to A, and $\frac{15}{32}$ of the remainder to B, he would have 68 acres left; and A's farm would then be equal to B's in extent. How many acres has each?

3. A, B and C start to walk in the same direction, B being 10 miles ahead of A, and C 5 miles ahead of B. A travels 6, B 5, and C 4 miles per hour. When will A be midway between B and C?

4. If a quantity of spirituous liquors is sold before arrival in port under agreement as follows: If 35 % strength above proof, at $5.40 per gallon, if over that strength to be paid in proportion. It arrives and is found to be 88⅕ above proof. What increase on 1000 gallons ought to be charged as an equivalent of 3⅕ % increase?

5. Two vessels have part of their cargoes, consist

ing of tea and sugar, of the same quality. One carries 104 cwt. of sugar and 26 cwt. of tea; the other 91 cwt. of sugar and 22¾ cwt. of tea. The former pays for duty 5 cwt. of sugar, 1⅓ cwt. of tea, and $1001.20; the latter pays 5 cwt. of sugar, 1⅛ cwt. of tea, and $915.60 Supposing the duty on tea to be 28 times that on sugar, and the price of tea 9 times that of sugar, what is the price of each article per lb. (112 lbs. to 1 cwt.)

6. Three men, A, B, and C., have $11,700 each; they wish to invest it in the 3% consols to pay them 4%. How much must they give per cent.; how much stock will each hold, and how much interest will each receive at the expiration of one year, A taking besides his own ⅓ of B's interest and ¼ of C's interest?

7. A man buys goods for a certain sum, and marks ⅓ of them at a profit of 24%, and ⅔ of them at a profit of 36%; but had he marked ⅔ of them at 24% gain, and ⅓ at 36% gain, he would have realized $240 less than before. Find the cost of the goods.

8. A and B start from the same place and in the same direction. A travels 30 miles a day, and after 10 days turns and goes back as far as B could travel in 5 days, he then turns again, and pursuing his journey overtakes B 26 days after they first set out. At what rate does B travel?

9. A merchant shipped 1000 barrels of flour from Toronto to his agent in New York, with instructions to sell at $8 per bbl. on a commission of $5\frac{1}{16}$%, and invests the proceeds in tea on a commission of 4%, but the price of flour having fallen, he sold at such a price as enabled him to send his employer $6887.50 worth of tea; at what rate per bbl. did he sell the flour? and how much did the merchant lose?

10. A B C is a triangle, the side A B 20, A C $\sqrt{881}$, and the perpendicular let fall from A on B C is 16. Find B C, and also the length of the line joining the vertex with the middle of the base.

XLIII.

D. McKay, Esq.—Newburg, P. S.

1. A gentleman is owing three notes to A. McLellan, one of \$100 due in 4 months, another of \$100 due in 8 months, and a third of \$200 due in 12 months. Should the three be converted into two for the same amount, the one to run just twice as long as the other, when ought they to be made payable?

2. If \$4 be allowed as discount off a bill of \$40 due 6 months hence, how much should be allowed off a bill of the same amount due 13½ months hence?

3. A merchant bought 70 yards of cloth 1¾ yards wide for \$4.50 per yard, but the cloth having been wet shrunk 5 % in length and 5 % in width, for what must it be sold per square yard to gain 12 %?

4. The flag pole on the University Grounds is 80 ft. high, at what height from the ground must it be broken off, so that the top of it may fall on a point 40 ft. from the bottom, the end where it was broken resting on the stump.

5. A gentleman bought a lot in Little York for \$56 who sold it to James Thompson for a certain sum, Thompson sold it to Miles Caton, Caton sold it to Jas. Smith for \$12096 each man gaining the same rate per cent.; find Thompson's buying and selling price.

6. If a certain number of workmen can do a piece of work in 25 days, in what time will 1¼ of that number of men do a piece of work twice as great, supposing that 2 men of the first set can do as much work in an hour as 8 of the second set can in $1\frac{1}{2}$ hours, and that the second set work half as long again as the first set ?

7. A person invests in the 3 per cents so as to obtain 3% clear on his investment, when there is an income tax of 7 cents in the dollar. What percentage clear does he obtain, if the tax be doubled ?

8. A tradesman, who is ready to allow 5 per cent. per annum, compound interest, for ready money, is asked to give credit for two years. If he charge $27.56\frac{1}{4}$ in his bill what ought the ready money price to have been ?

9. A room whose length is to its breath as 4 to 3 costs $96 to carpet it with carpet 27 inches wide at $1.50 per yard. What is the height of the room provided the cost of papering is to the cost of carpeting as 63 to 320, the paper being 2 ft. wide and costing 15 cents a yard ?

10. What is the weight of a hollow spherical iron shell 5 inches in diameter, the thickness of the metal being 1 inch, and a cubic inch of iron weighing $\frac{128}{500}$ of a pound.

XLIV.

W. Scott, B.A.—Model School, Toronto.

1. A can do a piece of work in $12\frac{1}{2}$ days which B can do in $13\frac{1}{3}$ days, and C in $12\frac{4}{5}$ days. They commenced to work together, but after working $1\cdot\dot{3}$ days A stops and B and C continue till the entire work is $\frac{3}{4}$ done, when B stops and C finishes the work. If the whole work is worth 12.12\frac{37}{49}$, what does each receive?

2. A commission merchant received a consignment of flour which he is to sell on a com. of 1¼ % and invest the proceeds in tea after deducting his commission on this new transaction at the rate of 1⅓ %. His total commission being $220, what did he invest in tea?

3. Two trains 100 feet and 120 feet long respectively, are observed to pass each other going in opposite directions in 8 seconds and going in the same direction in 15 seconds. At what rate were the trains going?

4. A wheat buyer sold ¼ of his wheat at a certain gain per cent., ⅓ of it at a gain of twice the former rate per cent, and the remainder at a gain per cent. of 3 times the first gain. If the gain on the entire stock was 26 %, what did he gain on each part? If he gained 5 % on the first part, what was the entire gain per cent?

5. If 70 men in 10 days of 9 hours each can dig a drain 90 yards long, 4 feet wide, and 16 feet deep, what length of a drain 5 feet wide and 18 feet deep can 100 men dig in 14 days of 10 hours each?

6. B bought 10000 centals of wheat at $1.20 per bushel of 60 lbs. and sold to A at an advance of 10 per cent. A gave his note for 4 months in payment. Money being worth 6 %, what was B's real gain?

7. A merchant wishes to mark some goods which cost $1.20 per yard, so that after making a reduction of 20 per cent. off the marked prices, he may yet gain 10 per cent. At what advance per cent. must he mark the goods, and if A buys without getting the reduction, what does he pay per yard?

8. How much must be invested in the U.S. 6's 5-20 at 120 currency interest payable in gold, so as to produce a net income of $6232¼ in gold after deducting an

income tax of 1½ per cent. payable in currency, the premium on gold being 40?

9. If 40 oxen can eat up a field of grass in 8 weeks, or 30 oxen can eat up the same field in 12 weeks, the grass growing uniformly, how many oxen can do it in 5 weeks ?

10. A invests $750 more than 50 % of his money in the Dominion 6's at 101; $9500 more than 33⅓ % of the remainder in bank stock at 116½, which pays a dividend of 8 %; and the remainder which is 25 % of the whole, is invested in building society stock at 179⅓, which pays a half-yearly dividend of 6 %. Brokerage being ¼ % on the first investment and ½ % on each of the other, what is the total income for the year?

XLV.

J. MORRISON, M. A., M. B.—NEWMARKET HIGH SCHOOL.

1. What is the difference between Bank Discount and True Discount?

The Bank Discount of a certain sum for six months is $188.49; what is true discount?

2. The longitude of Newmarket is 79° 30′ west; at a certain time it was as much past noon at Greenwich as it lacked of noon at Newmarket; what was the time then at the latter place?

3. A person buys ⅝ of a property, which afterwards falls 4% in value. He then sells 20% of his share for $300; what was the whole property worth at first?

4. The salary of the Principal of a High School was $1100 before the income tax was levied. How much must it now be with an income tax of 1½ cents per dollar, in order that he may still have $1100 per annum; $400 of his salary being exempted from taxation.

5. How far must a person proceed on a stage which travels $5\frac{1}{2}$ miles per hour in order that he may walk back at the rate of $2\frac{3}{4}$ miles an hour and be 5 hours gone?

6. In the winter term of 1876, the number of boys in the Newmarket High School was to the number of girls in the ratio of 4 to 3. In the spring term the decrease in the number of boys was $5\frac{5}{9}$ per cent., while the increase in the number of girls was $33\frac{1}{3}$ per cent., and the number of boys was to the number of girls as 8 to 9; there being 68 in all during the spring term. How many were there in the winter term?

7. An express train goes from Toronto to Stratford in the same time that a mail train takes to go from Toronto to Guelph, and that a freight train takes to go from Guelph to Stratford. If the velocities of the freight and mail trains are as 4 to 5, compare the velocities of an express and a mail train.

8. A certain sum amounts to $1488 in 8 months, and $1530 in 15 months, simple interest; what is the rate per cent.?

9. A person sold two watches, one for $60 gaining 4%, and the other for $60 losing 4%; how much did he gain or lose by the transaction, and how much per cent.?

10. A manufacturer exports a certain quantity of goods to the United States and after paying freight duty &c., realizes for them only $6440 which was at a loss of 8% on the cost price. If he had sold them at home he would have realized a profit of 8%; how much were they sold below the trade price at home?

XLVI.

W. E. Tilley, B. A.—Bowmanville High School.

✓ **1.** Find the cost of enclosing with a stone wall 10 ft. high, $2\frac{1}{2}$ ft. thick, an acre in the form of a square at $2.25 per perch of $22\frac{1}{2}$ cub. ft. $2088.92, 2112.08, $2112.09, or 2112.10

✓ **2.** A person sold a horse gaining $11\frac{1}{9}$% of the proceeds. Had he received $85 less he would have lost ∂$\frac{3}{5}$% of what the horse cost him. Find the cost and selling price of the horse. $160, $180

✓ **3.** A merchant marked his tea at a profit of $43\frac{3}{4}$%, but threw off 5 cents per lb. for cash. Had he marked his tea 5 cents per lb. higher, and then thrown off 10% for cash he would have gained $2\frac{1}{2}$% less on his outlay. Find the cost and marked price of tea per lb. $.80 $1.15

4. B invested $5000 in 8% accumulating stock at 112, on which nothing had been previously paid, securing $8000 stock. Four months afterwards he paid in $2000. Two months after he made the second payment, and just after the dividend had been declared he paid up the balance. Find amount of last payment and the rate % per annum which B received for his money.

✓ **5.** I bought $10000 stock through an agent who charged me ½% for buying. Had the stock been quoted 5% higher, and had I also bought through an agent at ½%, 1 should have received $$588\frac{4}{17}$ less stock on the same outlay. Find the price of the stock in the first case. $79\frac{1}{2}$

✓ **6.** My purse and the money in it are worth $128. If I spend 8% of my money and sell the purse for 5 times its value I shall then have $150.40. Find the value of my purse. $8

✓ 7. A merchant bought a quantity of goods for $4824.80, on which he is allowed 8 months' credit, and immediately sold them for $5800 on a note of 8 mos. He at once had the note discounted at the bank (no days of grace) at 9% per annum. How much % of his net investment did he gain, money being worth 8% per annum, and how much would he have saved if the note had been discounted at true discount. 17½ %. + $18

✓ 8. If the par of exchange be 4*s.* 8*d.* English for the American dollar, but if an American bill of exchange for $180 be negotiated in London for £35, how much per cent. is the course of exchange below the par of exchange.

9. A merchant bought 2 bbls. of beer and 3 hhds. of wine. He sold the wine at a profit of 17½% by which the profit on two gals. of wine is equal to the cost price of one gal. of beer. He sold the beer at a loss of 5%, but on the sale of the whole made a gain of $27.20 Find cost price of wine and beer.

10. At what % advance on cost must a merchant mark his goods so that after allowing 12% of his sales for bad debts, an average credit of 4 mos. and 15% of cost of the goods for his expenses, he may make a clear gain of 9% on first cost of the goods, money being worth 8% per annum ?

XLVII.

1. John D. Ham, of the village of Newburgh, has a farm adjoining the town of Napanee, containing $57\frac{77}{384}$ acres, which he wishes divided into square lots of the largest size possible. The farm is rectangular, its length being to its breadth as $4\frac{8}{9}$ to 1. How many lots will he have, and what the area of each lot in rods ?

2. If the simple interest on a sum of money for a given time and date be $\frac{a}{b}$ of the principal, show that the true discount is $\frac{a}{a+b}$.

3. Four men, A, B, C and D, start at the same point and in the same direction to travel round a circular island 10 miles in circumference, till they are all together again. A makes $\frac{2}{7}$ of a revolution in a day, B $\frac{3}{11}$, C $\frac{2}{21}$, and D $\frac{7}{22}$. How many miles does D travel more than B ?

4. The difference between the simple interest and true discount on a certain sum for 3 years 3 months 6 days, (=$3\frac{4}{15}$ years), at $4\frac{2}{7}$ %, is $98. What is the sum ?

5. A lady purchased a piece of cloth at 80 cents a yard, and lining for it at 30 cents, the cloth and lining containing 15 yards, and the price of the whole was $7. How many yards were there of each ?

6. A man at the time of his marriage agreed to give his wife $\frac{2}{3}$ of his estate, if at the time of his death he left only a daughter; and if he left only a son she should have $\frac{1}{3}$ of his property; but as it happened he left a son and a daughter, in consequence of which the widow received in equity $2400 less than she would have received if there had been only a daughter. What would have been the wife's dowry if he had left only a son ?

7. A man being asked the time of day, replied that it was between 5 and 6, and that the hour hand wanted as much of being at the point 6 as the minute hand had passed that point; what was the time ?

8. A alone can finish a piece of work in 12 day; B and C help him for a certain time, B quitting $5\frac{1}{2}$ and C

$2\frac{1}{4}$ days before the work is finished. How many days did B and C help A, provided A's efficiency is to B's as 3:2, and B's to C's as 4 to 3.

9. What must I ask a yard for silk that cost me $1.50, so that I may fall 10% and still make 20%, allowing 10% of the sales for bad debts ?

10. A man invests a certain sum in Toronto 6% debentures, selling at 6% discount, and $500 less in Bank of Toronto stock, selling at 5% premium, and paying yearly dividends of 10%. The income from the Bank stock is $100 more than from the debentures; find the amount of stock held.

XLVIII.

1. Show that $\left\{\frac{26}{333}-\frac{1}{23}-\frac{1}{29}\right\}\times\left\{\frac{14}{11}+\frac{8}{7}-\frac{1}{4}\right\}\times\left\{\frac{7}{10}+\frac{8}{15}\right\}=\frac{1}{4}\times\frac{1}{3\cdot5\cdot7\cdot11}$.

2. The manufacturer of an article makes a profit of 10 %, the wholesale dealer a profit of 15 %, and the retailer makes a profit of 25 %. What is the cost of the manufacture of an article which is retailed for 16 shillings ?

3. Three merchants contributed $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$, respectively, of the capital for a commercial adventure, on the condition that the gains should be divided at the rates of 7, 5, and 3 per cent. respectively, on the sums each had contributed. If the gains were $1500, what was the share of each ?

4. If pure gold be worth £4 per ounce, and pure silver 5*s.*, what percentage of copper must be mixed with pure gold in order that the value of a given quantity of the compound metal may be 15 times that of an equal weight of a mixed metal containing 80 per cent. of pure silver ?

5. If 20 men, 40 women, and 50 children receive among them $1400 for 7 week's work, and 2 men receive as much as 3 women or 5 children, what sum does a man, a woman, and a child receive weekly?

6. If the atmosphere were of the same density throughout as it is at the level of the sea, its height would be 26253 feet; find the weight of air which surrounds the earth, having given that 875·1 cubic feet of air weigh as much as ·1 cubic foot of mercury; and 30 cubic inches of mercury weigh 14·7 lbs.: supposing the earth a sphere of 8,000 miles in diameter, and having given the content of a sphere equal to two-thirds of its circumscribing cylinder, and the area of a circle equal to 3·1415926 times the square of the radius.

7. The estate of a bankrupt worth $84000 is to be divided among four creditors; the debts due to A and B are as 2 : 3, to B and C as 4 : 5, and C and D as 6 : 7; what must each receive?

8. If a manufacturer sell an article of which the first cost is $400, to a wholesale dealer at 10 per cent. profit, the wholesale dealer to the retailer at 15 per cent. profit, and the retailer to the consumer at 30 per cent. profit; what sum is paid by the consumer as profits in addition to the first cost of the article?

9. Paper money is at a discount of 20 per cent. A man buys goods marked £6 10*s.* (paper money), and tenders that sum in gold. How much paper money must he receive in change, 5 per cent being allowed for present payment?

10. The sides of a right angled triangle are 3, 4, and 5; find the length of the perpendicular from the right angle on the hypothenuse.

XLIX.

1. A teacher spends $\frac{3}{5}$ of his salary in board for himself and family, $\frac{1}{10}$ in clothing himself, his wife's clothing costs $\frac{5}{7}$ as much as his own, his daughters' $\frac{1}{2}$ as much as his wife's, his son's $\frac{4}{5}$ as much as his daughter's, and he lays by $115. What is his salary?

2. Three merchants have an interest in a steam vessel; A puts in $960 for six months; B, a sum unknown, for 12 months; C, $640 for a time not known when the accounts were settled; A received $1200 for his share, stock and profit; B, $2400 for his, and C, $1040 for his. What was B's stock, and C's time?

3. I wish to line the carpet of a room, $6\frac{1}{3}$ yards long and $5\frac{1}{2}$ yards wide, with duck $\frac{7}{8}$ wide. How many yards of lining must I purchase, if it will shrink 4% in length and 5% in width?

4. If a merchant wishes to draw $1275 at the bank, for what sum must he give his note at 60 days, discounting at 6%?

5. I received an 8% dividend on bank stock, and invested the money in the same stock at 80%. My stock having increased to $13,750; what was the amount of my dividend?

6. $\frac{3}{5}$ of $\frac{10}{9}$ of what number, diminished by $\dfrac{\frac{1}{2} \text{ of } \frac{3}{10}}{2\frac{1}{6}+\frac{7}{10}}$ leaves $\dfrac{(4\frac{1}{3})^3-1}{(4\frac{1}{3})^2-1}$?

7. A man purchased a farm for $3000, and agreed to pay principal and interest in 4 equal annual instalments. What was the annual payment interest being 6%?

8. At a certain time between one and two o'clock

the minute hand is between 2 and 3, and within an hour the hands will exactly change places. What is the first mentioned time.

9. Four towers—A 125 feet high, B 25 yards high, C 160 feet high, and D 70 feet high—stand upon the same plane; B directly south, and 40 rods from A; C east from B; and D south from C. The distance from A to C plus the distance from C to B is ½ a mile, and the distance from D to B is 82½ yards farther than the distance from C to D. Required the length of a line to connect the tops of A and D.

10. A gentleman wishes to set out a rectangular orchard of 1260 trees, so placed that the number of rows shall be to the number of trees in a row as 5 to 7. If the trees are 8 yards apart, how much ground will the orchard occupy?

CHAPTER VI.

EXAMINATION PAPERS

FOR

FIRST-CLASS CERTIFICATES AND UNIVERSITY HONORS.

I.

July, 1871.

1. Show how to find the least common multiple of two or more fractions. A, B, and C start at a given place to travel round an island 120 miles in circumference, A's rate is $5\frac{1}{2}$ miles a day, B's $8\frac{1}{4}$, C's $9\frac{3}{8}$; in what time will they all be together again?

2. Prove the rule for finding the present worth of a sum of money, payable at a future time, without interest. Bought a farm for \$5928.24 cash, and sold it for \$7830.40, payable in 18 months; what was the cash gain, money being worth 8 per cent.?

3. Paid 30% duty on a watch, and sold it at a loss of 5%; but had it been sold for \$21.06 more, there would have been a gain of $8\frac{1}{2}$%; find the cost price.

4. Distinguish specific and *ad valorem* duties. A quantity of raisins invoiced at \$877, cost \$990.25 in store, after paying duty and \$16.12 for freight; find rate of duty.

5. On what principle is the common rule for equa-

tion of payments based? Bought goods as follows: 1st April, $560 on 3 months; $600 on 4 months; $400 on 5 months; and $1120 on 6 months; find equated time of payment.

6. Define a logarithm; state the properties by which they facilitate arithmetical calculations. The log. of 2 is ·3010300, and log. of 3 is ·47711113; find the log. of $1+(\sqrt{\frac{1}{3}} \times \sqrt[3]{\frac{2}{3}} + \sqrt[4]{\frac{3}{4}})^{\frac{2}{3}}$.

7. A merchant in N. S. wished to pay $10,000 greenbacks to another in Boston, where gold was 134 and N. S. cy. 131; how much did he gain or lose, if, instead of remitting N. S. cy., he remitted American gold, purchased in N. S. at a premium of 3 per cent.?

8. On what condition do the respective shares of profit and loss in partnership depend? A, B, and C invest in business, B puts in his capital for 4 months, and claims $\frac{1}{3}$ of the profits; C's capital is in 8 months, and D invests $7000 for 6 months, and claims $\frac{3}{7}$ of the profits; how much did B and C put in? Explain your work fully.

9. A triangle, altitude 40 yards, is bisected by a line drawn parallel to the base; find the perpendicular distance between the base and the dividing line.

10. Find the area of an ellipse, whose axes are 26 chains and 22 chains 40 links.

11. The transverse and conjugate axes of a prolate spheroid are 10 feet and 7 feet; find the volume.

12. Into a conical glass (full of water), whose height is 7 inches, and diameter across the top 6 inches, a sphere of iron is gently let fall, of such a size that the plane of the glass's edge is tangent to it; how much water will remain in the glass?

II.

AUGUST, 1871.

1. Find G. C. M. of 8, $4\frac{1}{6}$, $4\frac{1}{5}$, $\frac{4}{45}$, giving reasons for the work.

2. Prove that a vulgar fraction will produce a finite decimal, or a pure circ. decimal, or a mixed circ. decimal, according as its denominator has *only* the factors of 10, none of such factors, *other* factors *also*; and that the number of finite figures will be equal to the greatest number of equal factors, 2 or 5, in the denominator.

3. State the different cases in percentage. To each of a class of 6 pupils 300 questions were proposed; the 1st answered 275, the 2nd 260, the 3rd 240, the 4th 200, the 5th 210, the 6th 180; what was the standing of the class?

4. In building a house, I paid $2\frac{1}{2}$ times as much for material as for labor; had the latter cost 8% more, and the former 10% more, the whole cost would have been $2872.50; find the actual cost.

5. A merchant consigns a quantity of flour to an agent in Montreal, who charges $2\frac{1}{2}$% commission for selling, and $8\frac{1}{2}$% for buying, with instructions to invest the proceeds (after deducting his commission for both transactions), in certain goods; the agent sells the the flour at $6.25 a bbl., and invests as directed, his entire commission being $482; how many bbls. flour were consigned?

6. Define the terms Company, Corporation, Charter, Firm, Joint Stock, Scrip. I had $8000 Bank of Toronto stock; when at a premium of 95% a new issue of stock was ordered, giving to each stockholder at a

premium of 5%, half as many shares as he already possessed; the market value of the stock then declined $15\frac{5}{13}$%. How much did I gain or lose by *not* selling out before the new issue?

7. Define the terms Insurance, Underwriter, Policy, Premium. For what sum must I insure property at $1\frac{1}{8}$% to *cover a loss* of $3955?

8. The duty on certain imported goods at 36% was $198, an allowance of 15% having been made at the Custom House for damage sustained by the goods after shipment. What was the invoice (cost) of goods?

9. "The course of exchange on England is usually given with reference to the *old par* of exchange." Explain this statement; shew that when sterling money is quoted at $9\frac{1}{2}$% premium, it is really at *par* according to present standard. A Bill of Exchange on Dublin for £720, cost $3472; find the *course of exchange*.

10. What relative quantities of sugar at 7 cents, 8 cents, 11 cents, and 14 cents, must be sold to realize an *average* price of 10 cents? Give *reasons* for your solution.

11. The three sides of a triangle are 30, 40, 48; find the segments into which the base is divided by a perpendicular upon it from the vertical angle.

12. If it cost $75 to inclose a circular pond containing 3 A. 2 R. 6 P., how much will it cost to inclose one of 35 A. 1 R. and 20 P.?

III.

DECEMBER, 1871.

1. Six men start together to travel in the same direction round an island, 60 miles in circumference;

their respective rates per day are 5, $6\frac{1}{4}$, $7\frac{1}{3}$, $8\frac{1}{4}$, $9\frac{1}{2}$, an $10\frac{1}{4}$ miles. In how many days will they all be togethe again?

2. A Note of $2,000, drawn at 60 days, payable at the Bank of Toronto, is discounted by a broker, at 2 % a month; what rate of interest does he make on his money? Explain the analysis.

3. Show how to find the amount of a sum of money at compound interest, for a given time and rate.

4. City of Toronto 6 % debentures having six years to run, are offered for sale; what price shall I pay in order to realize 10 % on my investment.

5. Define a logarithm; what is the log. of 2187 to base 3? Given log 2=·301030, and log. 7=·845098, find log. of ·0035.

6. A man bought a farm for $5,000, and agreed to pay principal and interest in four equal annual payments; find the annual payment, interest being at 6 %.

7. A, B, and C, form a partnership with a joint stock of $12,600; A's stock continues in trade six months, B's eight months, and C's twelve months. A's gain is $1,300, B's $1,500, and C's $1,800; what stock did each put in?

8. At what advance on cost must a merchant mark his goods so that after allowing 6 % of his sales for bad debts, 7 % of the *cost* for expenses, and an average credit of 6 months (money being worth 6 %), he may make a clear gain of 15 % on the first cost of the goods?

9. Find the present worth of 520.12\frac{1}{2}$, due nine months hence, supposing 4 per cent. stock to be at 92.

10. A society collected among themselves a fund of £413 8*s.* 9*d.*, each person paying as many pence as there were members. Find the number of members.

11. How much less will it cost to fence 40 acres of land in the form of a square, than in the form of a rectangle of which the length is 2½ times the breadth, the fence costing $2.25 per rod.

12. Find the radius of the greatest sphere that can be inscribed in a right cone whose height is 12 inches and base diameter 8 inches.

IV.

July, 1872.

1. A company with a capital of $2,000,000, paid 7% to the shareholders; afterwards a new issue of stock was ordered, and the profit to be divided became six times as much as at first, yet the company could pay only 8% dividends; find amount of new stock issued.

2. A produce dealer bought grain by measure and sold it by weight, gaining thereby 2% in the number of bushels; he sold at a price 6% in advance of his buying price, and received the sum of $5000. What did the grain cost him?

3. Bought 336 gallons of molasses at 87½ cents a gallon, and paid $7.50 for freight; if 5% be allowed for leakage, 4% of the sales for bad debts, and 1% of the remainder for collecting, what selling price per gallon will yield me a net gain of 25% on the whole cost?

4. A grocer buys tea at $1.20 a pound, and also some at 80 cents, and mixed them in such a proportion that by selling the mixture at $1.05 a pound, he gains 20%; in what proportion did he mix the tea?

5. A debt is to be discharged at the expiration of 9 months, ⅓ of it is paid immediately, ¼ in 6 months; when ought the balance to be paid?

6. A and B do a work in 12 days, B and C in 18 days, A and C in 30 days; all work together for 5 days and then A leaves; the other two go on for 6 days and then B leaves. In how many days will C finish the work?

7. The population of a country would increase annually 5%, were it not that emigration annually carries off ½% of the people; what will be the increase % in the population after 5 years?

8. I place a straight pole upon the bottom of a pond, so that it emerges perpendicular to the surface of the water, and mark a point 6 inches above the surface; then gently declining the pole (keeping its lower end fixed upon the bottom) from its upright position, I find that the mark becomes just submerged at the distance of 40 inches from the pole's first position; find the depth of the water.

9. The two sides of a triangle are 20 and 30 rods respectively, and the base 40 rods; find the length of the line joining the vertex with the middle point of the base.

10. Find the radius of a sphere whose volume is equal to the sum of the volumes of two spheres whose radii are two and three feet respectively.

V.

December, 1872.

1. Prove the Rule for multiplication of decimals. Explain the contracted method, and apply it to find the product of 5·127578 and ·0694526 true to six places of decimals.

2. A person increases his capital annually 20 per

cent.; at the end of three years, one year's interest at 8 per cent. on the accumulated capital is $576. With what capital did he start?

3. Extract the square root of ·00093636. Suppose you point thus: $\cdot\dot{0}0\dot{0}9\dot{3}6\dot{3}6\dot{0}$ and extract the square root, find the quantity (to three decimal places) which, multiplied into the erroneous result, will give the true result.

4. The old par of exchange between the United States and Great Britain was £1 = 4.44\frac{4}{9}$; in 1834 the U. S. Congress reduced the weight of the eagle to 258 grains, and in 1837 fixed its fineness at 900 thousandths pure; the mint price of English standard gold (22 carats fine) is £3 17*s*. 10½*d*. per ounce. From these facts show the truth of the statement, "By the new par of exchange sterling money is worth 9½ per cent. more than by the old par."

5. A grain dealer laid out a certain sum in oats, 20 per cent. more in barley, and 25 per cent. more in wheat than in barley and oats together; he sold the oats at a profit of 10 per cent., the wheat at a profit of 8 per cent., and the barley at a loss of 6 per cent., and received altogether $2599. Find the amount invested in each kind of grain.

6. If 3 men and 4 boys earn $25.20 in 3 days; and 6 men and 2 boys earn $22.80 in 2 days; find the amount earned by a man and a boy in one day.

7. A person ships 1200 barrels of flour to a commission merchant in Montreal, who agrees to sell it on a commission of 2½ per cent. He is instructed to pay the freight charges, which amount to 5 per cent. on the entire sum realized for the flour, deduct his commission of 3 per cent., and then invest the balance in Bank of

Montreal stock on a commission of 8½ per cent., which he is to take out of the amount in hand. His entire commission is $472½⅓. At what price per barrel is the flour sold ?

8. A merchant added every year 50 per cent. to his capital, with the exception of $1600 which is annually withdrawn for expenses ; at the end of four years his original capital is quadrupled : find its amount. What is the limit of the rate of gain in order that the other conditions of the question may be possible ?

9. Find the sum of money whose true discount for one year at 10 per cent. is greater by $$8\frac{58}{185}$ than the sum of the true discounts of one-half of it at 8 per cent. and the other half at 12 per cent. for one year.

10. £6,000 is invested in timber, which, at the expiration of 4 months, is sold for £6,420 : the 4 per cent. consolidated funds being at $88\frac{8}{9}$, find the gain per cent. on the transaction.

11. The diameter of a circle (radius=r) is produced until the part produced is equal to the radius, and from the extremity of the produced line tangents are drawn to the circle ; find the area of the figure formed by the tangents and the arc which they intercept ; find also the length of the arc.

VI.

JULY, 1878.

1. Among the candidates who presented themselves at an examination for first class certificates, A obtained 35 per cent. of the aggregate of marks, and failed to pass ; B obtained 80 per cent. of the aggregate, and thus obtained 120 marks more than the required mini-

mum for pass. If A had made 240 marks more he would have just reached the minimum for pass. Find the aggregate of marks and the percentage required to pass.

2. A person in London owes another in St. Petersburg a debt of 460 roubles, which must be remitted through Paris; he pays the requisite sum to his broker at a time when the exchange between London and Paris is 23 francs per £1, and between Paris and St. Petersburg 2 francs per rouble; the remittance is delayed until the rates of exchange are 24 francs per £1 between London and Paris, and 1½ francs per rouble between Paris and St. Petersburg; what did the broker gain or lose by the transaction?

3. Prove the rule for finding a residue of figures in the extraction of the square root. Extract the square root of 7 to 10 decimal places, and deduce $\frac{\sqrt{7}+1}{\sqrt{7}-1}$, $\sqrt{8+2\sqrt{7}}$.

4. A person starts with a capital which produces him 4% per annum compound interest; he spends yearly a sum equal to twice the original interest on his capital. Find in how many years he will be ruined, having given log. 2=·3010300. log. 13=1·1139434.

5. A man holds three notes, the first for $1000, due April 1st; the second, $1600, due July 1st; the third, $1200, due September 1st: he has them exchanged for two others, one of which is for $2000, payable May 1st; find when the other note matures.

6. If the cost of digging a trench varies as the product of the depth to which it is sunk and the quantity of earth thrown out, find the cost of digging a trench

270 feet long, 6 feet broad, and 12 feet deep, having given that a trench 4 feet broad and 9 feet deep costs 45 cents for each yard in length.

7. An insurance company issued a policy of insurance covering 80% of the estimated value of a ship and cargo, and 4½%, and immediately re-insured 50% of the risk in another company at 3½%. During the voyage the ship was wrecked, and the second company lost $900 more than the original insurer; what did the owners lose?

8. The expense of constructing a railway is $10,000,000, of which 40% is borrowed on mortgage at 6%, and the remainder is held in shares; what must be the average weekly receipts so as to pay the shareholders 5%, the working expenses being 65% of the gross receipts?

9. Three persons, A, B and C, form a partnership, contributing to the common capital $3500, $2200, and $2500 respectively; at settlement, A's gain is $1120, B's $880, and C's $1200: given that B's stock was in the business two months longer than A's, find the time the money of each continued in trade.

10. If gold can be beaten out so thin that a grain will form a leaf of 56 square inches, how many square inches of such gold-leaf will be required to make a cubic inch, the weight of a cubic foot of gold being supposed to be 1200 lbs. Avoirdupois?

11. The sides of a triangle, A B C, are 25, 30 and 35 feet respectively; on these sides external squares are described, A C D E, A B K H, B C G F: find the aggregate area of the squares described on the lines G H, K D, E F.

12. The sides of a rectangle have to each other the ratio of 1 : $\sqrt{3}$; and a perpendicular is let fall from one of the angles upon the diagonal : find in what ratio the diagonal is divided.

VII.

DECEMBER, 1873.

1. A person asked for a lot of land 40 per cent. more than it cost him, but finally reduced his price 15 per cent., gaining on the whole $1000 ; for how much did he sell the land ?

2. A Washington despatch to the *Globe*, September 14, says: "Explanation is made to the Treasury Department that the Coinage Act of 1873, by which the value of the pound sterling was altered from $4.84 to $4.8665, will increase the protective duties upon the imports from Great Britain to the United States by a little more than one-half of one per cent." Explain this statement, and find exactly the increase per cent. referred to.

3. The difference between the true and the bank discount of a note of $5300, payable in 9 months, is $18. Find the rate per cent.

4. A speculator gained 25 per cent. on three-fourths of his investment, and lost 10 per cent. on the remainder, and his net profits were $1000 ; what would have been the result had he lost 10 per cent. on three-fourths of his investment, and gained 25 per cent. on the remainder ?

5. A banker in Toronto remits $10,000 to
pool as follows : First to Paris, at 5 francs 40
per $1 ; thence to Hamburg, at 185 fran

marcs; thence to Amsterdam, at 17½ stivers per marc; thence to Liverpool, at 220 stivers per pound sterling; how much sterling money will he have in bank at Liverpool, and what will be his gain over direct exchange at 10 per cent. premium?

6. A merchant buys on January 1st a quantity of coffee at 25 cents a pound, and another quantity at 20 cents, and chicory at 8 cents a pound. On April 1st he mixes them together in the proportion of two parts of the better coffee to three parts of the poorer and five parts of chicory, and immediately sells half the mixture at 18 cents a pound. On 1st July he finds half the remaining stock damaged in consequence of a leak in his warehouse, and sells out the damaged part (12,700 lbs.) at 7 cents, and at the end of the year he sells the remainder, money being worth 7 per cent. during the year, and rent of warehouse being $200, payable at the end of the year; what must he get per pound for the portion last sold in order to make 5 per cent. on the whole cost at the end of the year?

7. Three men form a partnership: A's money was in 8 months, and he received $500 of the profits; B's was in 9 months, and he received $860 of the profits; and C's was in 10 months, and he received $800 of the profits; find the capital each put in.

8. A mortgage, dated 1st January, 1872, payable in three equal annual payments of $200 each, with interest, payable half-yearly at 6 per cent., is sold on the 1st July, 1872; what sum must the purchaser pay so that the investment may be worth 8 per cent.?

9. Two circles of given radii touch externally, and a common tangent is drawn intersecting the line joining their centres in P. If the tangent touch the circles

in Q, R, respectively, find the area of the rectangle contained by PQ, PR.

10. Find—

(1) The area of a quadrant whose radius is 4 rods.

(2) The solidity of a cone whose altitude is 6 feet and circumference of base 7 feet.

(3) The surface of a sphere 5 feet in diameter.

(4) The length of the side of a cubical vessel that shall contain three times as much as one whose side is 2 feet.

VIII.

June, 1874.

1. Express $16 \times \left\{\frac{1}{5} - \frac{1}{3 \times 5^3} + \frac{1}{5 \times 5^5} - \frac{1}{7 \times 5^7} + \text{\&c.,}\right\} - \frac{4}{239}$ in decimals accurately to five places.

2. A person annually increases his capital 20%, less a yearly expenditure of $500. At the end of four years his capital amounts to $18,052; find his original capital.

3. Having sold a quantity of flour on a commission of 3 %, and invested the proceeds in tea on a commission of 2 % on the price paid for the tea, I find my whole commission is $250. Find (1) the amount received for the flour; (2) the sum invested in tea.

4. The present worth of a debt due at a future time, as found by the common method (bank discount), will not amount to the debt if invested for the given time and rate. Show that the error varies exactly as the square of the time.

5. If the increase in the number of male and female criminals be 1·8 per cent., while the decrease in the number of males alone is 4·6 per cent., and the increase in the number of females is 9·8 per cent. Compare the number of male and female criminals respectively.

6. An insolvent compounds with his creditors for 65 cents in the dollar, and has $2,000 left. If he had made an assignment and surrendered all his assets to his creditors, they would have realized 69 cents in the dollar, after paying the expenses of the insolvency, amounting to 8 % of the whole estate. Find the assets and liabilities of the insolvent.

7. A loan of $1,000 is to be repaid in 3 years, in half-yearly payments; interest being 10 % per annum. Find the amount of each instalment.

8. A man invests $10,000 equally in shares of two banks. The shares of the one are at 3 % discount, and of the other at 5 % premium; the price of stock in the former suddenly rises 7 %, and that in the latter falls 6 % lower than when the purchase was made; if the man now sells out what will he gain or lose?

9. Examine the following solution of question 3, giving a proof of its validity or fallacy: 250÷·05=5000 : 5000+2 per cent. of it=5100=amt. received for the flour; 5000−3 per cent. of it=4850=amt. paid for the tea.

10. In a certain lake the tip of a lotus bud was seen 9 inches above the surface of the water; forced by the wind it gradually advanced, and was submerged at the distance of 36 inches. Compute the depth of the water.

11. *(a)* A field (rectangular) contains 27a. 3r. 8p., and ratio of its length and breadth is 21 : 13. How many rods of fence will be required to enclose it?

(b) A stone 20 in. long, 15 in. broad, and 8 in. thick, weighs 217 lbs.; find the dimensions of a similar stone weighing 1,125 lbs.

IX.

July, 1874.

1. A merchant sold $\frac{3}{8}$ of a lot of tea, at a loss of $12\frac{1}{2}$ per cent., $\frac{1}{3}$ the remainder, at a loss of 15 per cent., but realized a profit of 40 per cent. on what he had left: if he had received $25 more on this last sale, he would have gained $8\frac{1}{3}$ per cent. on the whole. Find the prime cost of the tea.

2. Shew how to find the G. C. M., and the L. C. M., of two or more fractions in their lowest terms.

3. An *ad valorem duty* of 15 per cent. is charged on a certain class of manufactured goods, yielding a revenue of $210,000; owing to a clamour for "protection to our infant manufactures," the duty is increased to 25 per cent., in consequence of which the consumption of the class of goods in question is diminished in the ratio of 7:10, and the goods actually imported are entered at a diminished price; the revenue on this class of goods being now $14,000 less than before the increased duty was imposed; find how much per cent. the *entered value* of the goods has been diminished.

4. 5 lbs. of coffee, and 4 lbs. of tea, cost $4.60; there is an advance of 25 per cent. on the price of the coffee, and a decline of $18\frac{1}{3}$ per cent. on that of tea, and 5 lbs. of the former and 4 lbs. of the latter still cost $4.60. Find the price of each at first.

5. Show how to solve by analysis a question in compound proportion:

If 50 guns, firing five rounds in eight minutes, kill 800 men in 70 minutes, how many guns firing eight rounds in 10 minutes will kill 800 in 50 minutes.

6. A owes B a sum of money payable at the end of 4 years; B accepts A's offer of immediate payment of the amount, less mercantile discount, at the rate of 10 per cent. per annum; he loans the amount received at 10 per cent. interest, and finds that if he had waited for payment till the end of the four years, he would have been $160 better off. Find the amount of A's debt. The other conditions being supposed the same, what would B have lost had the debt been payable in two years? Eight years?

7. 5 men all started together to travel in the same direction round an island 90 miles in circumference, and continued travelling till they all came together again. Their respective rates were 5, 6¼, 7½, 8⅓, and 10¼ miles a day. How many miles did the first man (whose rate was five miles a day) travel?

8. A person pays $482 for the insurance of goods at 8¾ per cent.; and he finds that if the goods are lost, he will receive from the insurance company the value of the goods, the premium of insurance, and $40 besides. Find the value of the goods.

9. I borrow $4500, agreeing to pay principal and interest in four equal annual instalments. Find the annual payment, interest being calculated at 6 per cent.

10. (1) The length of a block of marble, containing 105 cubic inches, is 7 inches, find the length of a similar block containing 22,680 cubic inches.

(2) A cone, whose slant height is 18 inches, and the circumference of whose base is 30 inches, is divided into

two equal parts by a plane parallel to the base; find the height of the frustrum.

X.

DECEMBER, 1874.

1. A merchant begins business with a certain capital; he gained 20% the first year, which he added to his capital, and 87½% the second year, which he added to his capital; in the third year he lost 40%, and found that he was $200 worse off than when he began business. Find the amount of capital with which he started.

2. A tradesman deducts from his prices at 6 months, 6 per cent. for cash and 4 per cent. for three months' credit. At his six months' price he gains 80%. What advance on the cost price does he receive, when he sells at three months' credit, an article that for cash would bring $4.70?

3. A crew can row up a stream a certain distance in 64′ and back again in 60′; determine the distance, the rate of the stream being half a mile an hour.

4. A farm is let for £96, and the value of a certain number of quarters of wheat. When wheat is 88 shillings a quarter, the whole rent is 15% lower than when it is 56 shillings a quarter. Find the number of quarters of wheat which are paid as part of the rent.

5. There are two sets of workmen; 7 of the first and 4 of the second can do a certain work in 6 days, while 5 of the first and 6 of the second can do it in 5 days—it is required to complete the work in 4 days, and 6 of the first set are employed. Find the least

number of the second set that must be added to complete the work in the specified time.

6. A municipality borrows $20,000, payable in 10 years. Obtain an expression for the tax annually to be raised and deposited as a sinking fund, so that at the end of the time the debt, principal and interest shall be liquidated—money to bear interest at 6 per cent.

7. Apply the *contracted* methods to find the product of $24.\dot{6}8$ and .2887 correct to six places ; and the quotient of 8.1244 by 4.4208 correct to three places of decimals.

8. If 14 oxen eat 2 acres of grass in 8 weeks, and 16 oxen eat 6 acres in 9 weeks, how many oxen will eat 24 acres in 6 weeks, the grass on each acre being equal at first, and growing uniformly?

9. Two men form a partnership for 7 years; A is to have 87½% of the net annual profits for the first half of the time, and 50% of them for the remaining half; after 4½ years the annual profits increased in the ratio of 7 to 6, owing to a reduction of duties, and at the same time an income tax of 2¼½% was imposed; at the close of the partnership A's share of the total net profits was $17,180. Find the annual profits of the business during the first 4½ years.

10. (1) The sides of a triangle are 9 chains 62 links, 6 chains 88 links, and 7 chains 20 links; find its area.

(2) Find area of ellipse, axes 38 feet 5 inches and 20 feet 8 inches.

(3) Find contents of frustrum of a cone, diameter of larger end being 2½ inches, of smaller, 1 inch, and depth 5 inches.

XI.

June, 1875.

1. A grocer buys 150 lbs. of coffee at 14 cts. per lb., and 89 lbs. of chicory at 6 cts. per lb.; he pays an import duty of 12 % *ad valorem*, and mixes them and sells the mixture at 25 cts. a pound, gaining, by use of a false balance, ¼ oz. on every apparent lb. sold. Find the profit per cent. made on his outlay.

2. When U. S. 6's 5-20 are quoted 107½ in New York, and 70½ in London, gold being at a premium of 89 %, and exchange on London 9¾ %—how much is saved by buying U. S. bonds to the amount of $20,000 in the better market?

3. $73 is due April 5th, $145 May 8th, and $600 July 14th; determine the time at which they all with absolute jsutice should be paid together, allowing interest at 5 per cent.

4. Show that a broker by employing bank instead of true discount increases his discount *rt* per cent., where *r* is the rate per cent. and *t* is the time.

5. An importer purchased goods, paying freight 10 % and duty 20 % on the original outlay; he was obliged to sell the goods at a loss of 20 %; but had he received $585 more than he actually sold them for, he would have made a profit of 4 %. Find the original cost of the goods.

6. A market boy received 800 oranges to sell on commission; he was to receive 1⅓ cents for each orange he sold, and was to pay 4⅔ for each orange he ate; he received $2.38. How many oranges did he sell?

7. It is agreed that the rent of a farm shall consist of a fixed sum together with a certain number of bushels of wheat; when wheat is 56*s.* a quarter, the rent is £250; when wheat is 60*s.* a quarter, the rent is £260; what will be the rent when wheat is 80*s.* a quarter?

8. Three boys, A, B, C, were employed to hoe a field of corn for $50.50; A could hoe $4\frac{1}{6}$ rows per hour, B $3\frac{3}{4}$ rows per hour, and C $2\frac{1}{3}$ rows per hour; it so happened that when all first came to the end of a row at the same instant, the work was completed. How long were they at work, and how much in equity ought each to receive?

9. A consignor sends 1000 bbls. of flour to a commission merchant, with instructions to sell it and remit the net proceeds by draft. The consignee pays freight and expenses, $240.80; sells the flour at $8.50 per barrel; charges $2\frac{1}{2}$ % commission, and pays $\frac{3}{8}$ % premium for draft; how much does the consignor receive?

10. A's money is 75 % of B's; if A's money together with 80 % of B's be put on interest for 4 years at 10 % per annum compound interest, the amount will be $14641. How much has each?

11. *(a)* A field in the form of a trapezoid has an area of 3 roods; the perpendicular distance between the parallel sides is 8 rods, and one of these sides is 18 rods; find the other parallel side.

(b) If a spherical shell when formed into a solid sphere be equal in volume to its own cavity; what must be the thickness of the shell?

XII.

July, 1875.

1. On May the 1st, 1875, a banker discounts a note of $600 at 8 per cent., and by so doing receives 8⅓ per cent. on his money. Find when the note was payable.

2. In an election of a member of Parliament 10 per cent. of the constituency refused to vote; of two candidates, one received 47 per cent. of the votes of the whole constituency, and was elected by a majority of 80; find the number of votes cast for each.

3. A and B are employed upon a job for which they are to receive $4. A begins work in the morning half an hour before B; and at noon the amount of work he has accomplished is greater than that of B by $\frac{1}{20}$ of the whole work to be done. They rest at noon for an hour. On resuming their labor, B works with diminished energy, while A goes on with the same efficiency as before. A stops working at 6 p.m.; and B, continuing to work alone, finishes the work at 7 p.m. If paid in proportion to the quantity of work each has done, find the ratio of the amounts they receive.

4. Bought in London 2000 yards of broadcloth at 15*s.* 9*d.* sterling a yard, and paid for it by bill of exchange. After paying 50 per cent. *ad valorem* duty, at what price per yard in currency must it be sold in New York to make 25 per cent. currency on the purchase, exchange on London being 9½ per cent., and gold at a premium of 35 per cent.

5. A person invests $200 at the end of each year, and at the end of the third year finds he is worth $800; find the rate per cent. compound interest.

6. A person sells $12,000 Canadian bank stock which pays half-yearly dividends at 4 per cent., at 112, and invests in American railway stock at 98$\frac{3}{4}$ currency. Gold being quoted at 112$\frac{3}{4}$, (and Canadian currency considered equal to gold) what yearly dividend should the latter stock pay in order that the person's income may be unchanged?

7. A Canadian retail dealer buys from a Toronto wholesale merchant at an advance of 85 per cent. on the latter's sterling cost, the English currency, after such advance, being converted into Canadian at 20 cents to the shilling. The retail dealer pays $4.44 for a certain article: determine the whole merchant's gain per cent., allowing 75 cents for insurance, freight and customs, and taking exchange at 109$\frac{1}{2}$, brokerage $\frac{1}{8}$ per cent.

8. A and B invest a certain sum of money in a business. A invests 66$\frac{2}{3}$ of what B invests. At the end of seven months A withdraws 25 per cent. of his capital, and at the end of nine months B withdraws 25 per cent. of his. The profits at the end of the year are $668: how should this sum be divided?

9. A railway train 44 yards long passes a man (A) travelling (in the same direction) at the rate of 6 miles an hour in 8 seconds. Half an hour after (A) it meets another traveller (B) and passes him in 2$\frac{1}{12}$ seconds. Determine the distance from the point where the train leaves A at which A and B will meet.

10. Fencing is worth 20 cents a yard, and the greatest amount of land that can be enclosed in rectangular form for a certain sum of money is 52 ac. 173, 156 yds. Find the cost of the fencing.

XIII.

JULY, 1876.

1. Prove the rules for pointing in Multiplication and Division of Decimals.

Reduce to its simplest form,

$$\frac{(\cdot075)^5+(\cdot05)^5}{(\cdot075)^4-(\cdot075)^2\,(\cdot025)^2+(\cdot05)^4}$$

2. The owner of some city property allows his agent 5% for collecting his rents; the amount which he annually pays for insurance and repairs (and on which he pays no income tax) is 8$\frac{4}{7}$% of his net income; his income tax at 2 cents 7$\frac{1}{2}$ mills on the dollar, is \$198.25. Find the gross rents from his city property.

3. Reckoning commercial discount at 8 %, how many years would a bill have to run so that the holder would be willing to pay something to take it off his hands? Shew that the error in computing commercial discount, instead of true discount, varies nearly as the square of the time, when the time is small, and where the discount is small compared with the debt.

The interest on a sum of money for 2 years is \$71$\frac{133}{160}$, and the discount for the same is \$68$\frac{17}{20}$; find the rate % and the sum of money.

4. A Building Society wishes to realize 10% on its loans; the instalments paid to it can be reinvested at 8% per half year; extending the formula $A=PR^n$ to include the case of n being fractional, shew that the quarterly instalment on a loan of \$1000, payable in 6 years, is $1.000(1.1)^6\times\dfrac{\sqrt{1.08}-1}{(1.08)^{12}-1}$.

5. A retail dealer bought a quantity of broadcloth, and marked it for sale at an advance of 20% on cost; in measuring it off to the customers he used a false measure, by which he gained on the entire sale an additional sum of $89, making on the whole a profit of $379.20. Find the cost price of the cloth and the length of his yard stick.

6. By the construction of the Canada Pacific Railway, 80% is added to the debt of the Dominion; for the next fourteen years after the completion of the road $5,000,000 of the principal, in addition to the interest, is annually paid off, and at the end of that time the rate of interest on the national debt is reduced 10%; if, in spite of these reductions, it be found that the interest on the public debt is still 20% more than before the increased debt, find the cost of the Pacific Railway.

7. Examine the merits of the following definition: "Four quantities are said to be proportional when a part of the first is contained in the second as often as a like part of the third is contained in the fourth." Give examples of its failure.

Where do you consider that the notion of ratio is first introduced in works on arithmetic?

Given that the distance through which a body draws another in one second varies as the force of attraction; that the force of attraction is directly proportional to the mass of the first body, and inversely to the square of the distance from the centre; that the mass is proportional to the product of the density and volume; and that when the earth's volume and density are each unity, those of Jupiter are 1387.431 and .22 respectively. Find how far a body will fall from rest in one second at the surface of Jupiter, if at the surface of the earth it fall through 16.08 feet in the same time.

8. A person has an estate which yields a net income of £1620, after paying expenses to the extent of 10%. He sells it and invests the proceeds in the $4\frac{1}{2}$ per cents at 96, the income now being subject to charges at 5%, and his net income is £16 17*s.* 6*d.* less than before. Find for how many years' purchase on the gross income he sold his property.

9. English standard gold is $\frac{1}{12}$ alloy, and $44\frac{1}{2}$ guineas weigh one pound troy; the weight of a shilling is $87\frac{3}{11}$ grains troy, and pure silver is $14\frac{1393}{4840}$ heavier than an equal value of pure gold. If silver were to fall one per cent. in value, find what change would have to be made in the alloy in a shilling in order that 20 shillings might still be equal to £1, the alloy being supposed of the same specific gravity as silver, and the weight of the shilling unchanged.

10. (*a*) The three sides of a triangle are 20, 30, and 25 respectively. Find the position of the point which is equally distant from the three angles.

(*b*) Two sides of a triangle are 8 and $12\frac{1}{2}$ respectively. and the line bisecting the angle they contain is 6. Find the third side.

XIV.

1. At what per cent. in advance of cost must a merchant mark his goods so that after allowing 8% of his sales for bad debts, an average credit of 6 months and 6 per cent. of the cost of the goods for expenses, he may make a clear gain of 15% on the first cost, money being worth 8% ?

2. A merchant barters 60 yards of silk, which cost him $1.50 a yard, but which he sells at $2.50, giving 9 months' credit, for cloth which another merchant sells for $2, giving 6 months' credit. How much cloth ought the first merchant to receive?

3. Three merchants enter into partnership; the first (A) puts in $400 for 6 months; the second (B) $550, for a time not known; the third (C) an unknown sum for 12 months. At settling, A received for his stock and profit $424, B $605 for his, and C $120 for his. Find B's time and C's stock.

4. The Toronto Trust and Loan Company advance $2400 upon a mortgage on a farm on the following conditions: The principal to be repaid in 20 years by equal annual instalments, and interest at the rate of 6% to be charged on the part unpaid. If the sum due in any particular year be $177.60, how many previous annual payments have been made?

5. At a certain time between 2 and 3 o'clock, the minute hand was between 3 and 4. Within an hour after, the hour hand and minute hand had exactly changed places with each other. What was the precise time when the hands were in the first position?

6. If $10 be allowed as 6 months' discount off $60, and at the same rate of interest $3 be allowed off a bill of $33, for how long a period had the latter to run?

7. A merchant in London remits to Amsterdam £1000, at the rate of 18*d*. per guilder, directing his correspondent at Amsterdam to remit the same to Paris, at 2 francs 10 centimes per guilder, less $\frac{1}{8}$ per cent. for his commission; but the exchange between Amsterdam and Paris happened to be, at the time the order was received, at 2 francs 20 centimes per guilder. The mer-

chant at London, not apprised of this, drew upon Paris at 25 francs per pound sterling. Did he gain or lose, and how much per cent.?

8. A gentleman has an estate that brings him in \$3000 a year, but this gross income is liable for rates and repairs to the extent of 12 per cent. He sells it at 24 years' purchase on the gross income, and invests the proceeds of the sale in 3 per cents at $97\frac{1}{2}$. What difference is caused in his income?

9. I have a board whose surface contains $49\frac{5}{8}$ square feet; the board is $1\frac{1}{2}$ inches thick, and I wish to make a cubical box of it. Required the length of its side.

10. A man standing 40 feet from a building, which is 24 feet wide, observed that when he closed one eye, the width of the building just hid from view 90 rods of fence, inclined at an angle of 45° to the side of the building; what must be the distance between the eye of the observer and the remoter point of the fence?

XV.

1. Find an approximation which shall differ from $\sqrt{365}$ by less than $\frac{1}{1000}$.

Find the numerical value of

$$\frac{(2+\sqrt{3})^{\frac{3}{2}}+(2-\sqrt{3})^{\frac{3}{2}}}{\sqrt{6}}.$$

2. A borrows a sum of money from B at $3\frac{1}{2}\%$, B borrows the money from C at $3\frac{1}{3}\%$ for 7 months in order to lend it to A; A repays B the sum with interest before the 7 months have expired; and when B repays C, he finds he has neither gained nor lost anything. Fo how long did A require the money?

3. Prove that if from any number be subtracted the sum of its digits, the remainder will be divisible by 9; and hence show that a number will be divisible by 3 or by 9 if the sum of its digits is so divisible.

4. A builder signs a contract estimating $\frac{2}{3}$ of the whole cost for materials, and $\frac{1}{3}$ for labour. When $\frac{1}{3}$ of the time has elapsed, 30% of the material rises 10%; and on the expiration of half the time, 60% of the labor obtains a rise from 16 cents to 18 cents per hour. Supposing a profit of 5% to have been charged originally, what is the ultimate gain or loss per cent.?

5. Desiring to remit £1430 to Portugal, will it be better for my Portuguese correspondent to have a direct remittance from London to Lisbon at 68*d.* per milree, or to have the money transmitted through Amsterdam and Paris, the exchange between London and Amsterdam being at 37*s.* 3*d.* Flemish per £ Sterling; and between Amsterdam and Paris at 56 pence Flemish for 3 francs, while between Paris and Lisbon the exchange is 460 rees for 3 francs, and expense of $1\frac{1}{2}$% being incurred in the circuitous course? How many milrees will be saved by taking the more profitable course? (1000 rees=1 milree.)

6. A boatman rows 5 miles with the tide in the time he would take to row 3 miles against it; but if the hourly velocity of the current were $\frac{1}{2}$ a mile more, he would move twice as rapidly with the tide as against it. Find his power of rowing in still water.

7. A man owes a debt to be paid in four equal instalments at the end of 4, 9, 12, and 20 months respectively; and he finds that true discount being allowed at 5% per annum, $3000 paid at present will discharge the whole debt. How much did he owe?

8. A tradesman buys a quantity of sweets at 60 cents per pound Avoirdupois, and retails it at 5 cents per oz. Troy. Another buys at 60 cents per lb. Troy, and retails it at 5 cents per oz. Avoirdupois. Find the ratio of their profits per cent.

9. A clock that gains 24 seconds per hour is set to right time at a quarter to 5 p.m. What will be the right time between 8 and 9 o'clock the same evening, when the hour and minute hands point in exactly opposite directions?

10. The perimeter of a right angled triangle is 25. and the radius of the inscribed circle is 2; determine the sides of the triangle.

XVI.

1. Taking the ordinary definitions for the numerator and denominator of a fraction, what is the meaning of $\frac{3}{4} \times \frac{5}{7}$ and $\frac{3}{4} \div \frac{5}{7}$.

2. A, B, and C start from the same point to move round a course of 6 miles, at rates of 3¼, 4¼, and 5¼ miles per hour, respectively, C's direction being opposite to that of A and B. Find when first they will be together at a point 3 miles from the starting place. Show that they will never be together at a point 1⅓ miles from the starting place.

3. (1.) What is the least number which being a cube is also divisible by 4, 5, 9, and 12.

(2.) On a railway are two parallel tracks; on one of these trains pass a certain point every 49⅓ minutes; on the other, the same point every 52¼ minutes: a train on the former track has just passed this point, and in 17½ minutes one on the latter will do so. Will trains on these tracks ever pass this point at the same instant? If so in what time from the passage just mentioned?

4. A person has a certain amount of bank stock which he sells at $110\frac{1}{8}$ and invests the proceeds in 5 per cents at $79\frac{7}{8}$. When this has risen $5\frac{1}{4}$ per cent., he purchases the same amount of the original stock as he held at first at $109\frac{7}{8}$,—which now pays 8 per cent.—and finds that, while $110 remain in cash, his income has fallen $8. Find the percentage originally paid by the bank stock, allowing $\frac{1}{8}$ per cent. brokerage on each transaction.

5. Shew that the difference between two numbers having the same digits is divisible by 9 whatever be the order of the digits in the second number.

6. A and B are moving round a circle 10 miles in circumference at rates of $8\frac{1}{2}$ and $5\frac{1}{2}$ miles per hour, respectively. A passes a certain point one hour ahead of B. Find the point which first A shall pass $1\frac{1}{2}$ hours ahead of B, and determine in what time this will take place.

7. Shew how to find the present worth of an annuity reckoning compound interest.

8. A, B, and C join in a business to which they are to contribute in the proportion $1\frac{1}{2}$, $1\frac{5}{9}$, $1\frac{11}{18}$ respectively. A pays down $1102·50, B $1026, and C $1068·75; what must each pay to the others or receive from them to make the proportion of capital according to agreement?

9. Suppose that a tank receives a uniform and continual supply of water, and that when it contains a certain quantity, 12 equal taps being set open would empty it in $7\frac{1}{2}$ minutes, or 7 of the same taps would

empty it in 16 minutes; how many of the taps would empty it in 50 minutes?

10. The radius of a circle being 10 feet, find the side of a square inscribed in a circular segment which is contained by a chord and one-third part of the whole circumference.

XVII.

D. McKay, Esq., Newburg, P. S.

1. A Toronto wine merchant buys three kinds of wine and mixes them together in this proportion: 1 cask of the first, the price of which is $80 a cask; 3 casks of the second, the price of which is $90 a cask; and 2 of the third kind. He keeps this mixture for 12 months, and then it sells for $104.50 a cask, clearing 10%, after allowing 4% for interest of capital. What was the original price of the third kind of wine?

2. If $10 be allowed as discount off $250, due a certain time hence, what would be the discount if it had twice as long to run?

Suppose compound interest what then would be the answer to the above question?

3. A tradesman marks his goods with two prices, one for ready money and the other for 12 months' credit, allowing, as he says, discount. Now if the credit price of a yard of silk be $1.80, and the cash price $1.20, and if the credit price be marked 28½% above what he gave for it; how many yards must he sell at cash price to gain $60.

4. The present value of a freehold estate of $100 per annum, subject to the payment of a certain sum at

the end of every two years, is $1000, allowing 5% compound interest. Find the sum.

5. Suppose a clock to have an hour hand, a minute hand and a second hand, all turning on the same centre. At 12 o'clock all the hands are together. How long will it be before the hour hand will be equally distant between the other two?

6. A carpenter has a plank 1 foot wide, 22⅞ feet long, and 2¼ inches thick; and he wishes to make a box whose width shall be twice its height, and whose length shall be twice its width. Required the dimensions of the box.

7. A and B engage to reap a field for 4*l.* 10*s.*; and as A could reap it in 9 days they promise to complete it in 5 days. They found, however, that they were obliged to call in C, an inferior workman, to assist them for the last two days, in consequence of which B received 3*s.* 9*d.* less than he otherwise would have done. In what time could B and C reap the field?

8. A, B and C bought a grindstone for which they paid $10.60. B paid 20% more than A, and 10% less than C. The diameter of the stone was 65 inches, and the diameter of the place for the shaft 8 inches. What sum did each pay, and how much must each grind off from the semi-diameter to obtain his proper share of the stone?

9. There is a conical glass 6 inches high, 5 inches wide at the top, and ⅛ of which is filled with water. What must be the diameter of a ball let fall into the water that shall be immersed by it?

XVIII.

W. B. Harvey, Esq.—Collingwood High School.

1. There are two bars of metal; the first contains 16 oz. of silver and 8 oz. of tin, the second contains 27 oz. of silver and 6 oz. of tin, how many oz. must be taken from each bar to form a bar that shall contain 19 oz. of silver and 5 oz. of tin?

2. There are two armies—3/8 of the first are killed in battle and 3/4 of second; then 2/3 of the remainder of first army desert to the second and 3/4 of remainder of second desert to the first; each army now contains 24,000 men; how many in each army at first?

3. A and B engage in trade, B's capital is 3/4 of A's. A loses $200 and B gains so that his capital is now 5/8 of A's. Should A now give to B 1/5 of his present capital, and B give to A 1/3 of his, they would each have equal sums; find original capital of each.

4. A farmer mixes corn and wheat in the ratio of 8 to 9; had he taken 12 bushels more corn and 9 bushels more wheat the ratio would have been as 12 to 13; how many bushels of each did he take?

5. A owes B $1000; but is able to raise only $600, with this sum he proposes to pay part of the debt and the interest in advance on the remainder on his note for 2 years at 10 %. For what sum ought the note to be drawn?

6. A merchant sends to his agent, pork, wheat, and cash, to the value of $13300, with instructions to sell the pork and wheat and invest the whole proceeds and the cash in buying goods. The agent charges 5 % for selling pork, 4 % for selling wheat, and 4 % for buying goods, his whole commission amounted to £1100; find amount of cash and value of pork and wheat sent by the merchant.

7. How long will it take $4000 to amount to $5000 at 5 % compound interest?

8. A merchant deducts from his prices at 6 months 6 % for cash and 4 % for 3 months' credit. At his 6 months' prices he makes a profit of 30 %. Find the cash price of an article that he sells, on three months' credit, at an advance of $95\frac{5}{13}$ cents on cost.

9. If 3 acres of grass, with the growth thereon, keep 18 oxen 9 weeks, and 4 acres keep 20 oxen 6 weeks, for how many weeks can 36 oxen graze on 6 acres?

10. A field is 80 rods long, 40 rods broad at one end 60 rods at the other. How far from the smaller end should the field be divided crosswise so that the parts may be equal in area, and what will be the breadth where cut?

XIX.

D. A. Maxwell, Esq., Strathroy High School.

A and B engaged to work for a certain number of days. A was absent 2 days, and received $81; B was absent 12 days, and received $36. If the days of absence had been reversed, they would have received equal amounts. For how many days were they engaged and at what rate?

2. Two lots are assessed for a drain in the sums of $76 and $79, the principal to be paid in five equal annual instalments, with interest at 6 % per annum on the unpaid principal. Debentures were issued June 1st,

payable Jan. 5th. Three year's rates have been levied, when it is found that the clerk has inadvertently charged the lots at $79 and $76. What payments must each lot make during the next two years so that the mistake may be rectified. (*Ontario Teacher.*)

3. If a sum of money is borrowed for n years at a given rate r on one dollar per annum, the interest being paid q times per year. Show that the compound interest : simple interest :: $2q+(qn-1)r : 2q$, nearly.

4. What is the value of the U. S. gold eagle (232 grains fine gold) at the French mint, a kilogramme of standard gold ($\frac{9}{10}$ fine) being worth 3100 francs, and a mintage of 6f. 70c. being charged?

5. In each of two chests there are two kinds of tea, the proportions of good tea to the poor kind in the first chest being as 3 to 7. If equal quantities be taken from each chest and mixed, the good tea in the mixture is $81\frac{9}{11}$ % of the poor kind; but if four times as much be taken from the first as from the second, the difference between the quantities of good and poor tea is 140 % of the quantity taken from the second. Find the proportions in which the teas are mixed in the second chest.

6. I borrow $1,000 on condition that I repay $10 at the end of every month for 10 years. Find an equation which will determine the rate of interest I pay.

7. Prove that a number will be divisible by 11 if the sum of the digits in the even places differs from that in the odd places by a multiple of 11.

8. A grocer wishes to mix together teas at 50, 70, and 90c. per lb., with 40 lbs. at 55c., 60 lbs. at 60c., 80 lbs. at 65c., and 100 lbs. at 90c., that he may have 1230 lbs. which he can sell at $\$1.06\frac{62}{125}$ per lb., using a

15 oz. weight for a pound, giving a credit of 4 months when money is worth 12 % per annum, making a present gain of 20 %, allowing 10 % for bad debts, and adding $10.60 to the cost price of the tea to cover incidentals. How many pounds at each of the given prices may he take ?

9. A certain piece of goods is marked with two prices, one for ready money, the other credit. If the credit price be $2.60, and the cash price 90 % of it; and if the credit price is 30 % above cost; how much is the cash price above cost ?

10. Four places, A, B, C, D, are so situated that the distance AD is 50 miles, and from D to the middle of AC is equal to the half of AC. The angles BAD, BDC are equal, and BDC is double of BDA. Find the distances AB, BC, CD and BD.

XX.

James Bruce, Esq.—Waterdown High School.

1. The simple interest on a sum of money for one year is $45 and the compound interest on the same sum at the same rate for the 5th year is $54·69778125. Find the sum and the rate per cent.

2. What sum invested at 5 % per annum, simple interest, would secure an annual income of $400 for 3 years.

3. Required the present worth of a pension of $160 to continue 4 years, supposing money worth 4 % per annum compound interest.

4. What must the perpendicular depth of a cistern in the form of an inverted cone having the angle at the apex° 60, to contain 400 gallons of water ?

5. A merchant bought some goods for \$620 with 8 months credit, and sold them forthwith on 8 months credit, gaining thereby 10 %. If he had sold the goods for \$10 more, giving 6 months credit, what would have been the gain per cent. taking money worth 5 % per annum?

6. A grocer had three kinds of tea worth 60c., 70c., and \$1 per lb. respectively. How much of the \$1 tea must he mix with 20 lbs. of the 60c. and 70 lbs. of the 70c. tea, so that by selling the mixture at \$1 a pound, he may clear 10 % on the cost after allowing a discount of 10 % to the purchaser?

7. A merchant in Toronto remits to his agent in Manchester \$2000 directing him to deduct his commission at 2% on the purchase, and invest the remainder in cotton goods at 4d. sterling per yard. The goods arrive in 8 months after sending the money. When the goods arrive he pays \$130 for freight, insurance, etc., and an *ad valorem* duty of 4 %. Three months after the goods arrived they were sold at 12 cents a yard, giving 6 months credit. Money being worth 8 %, find the merchant's gain % on investment.

8. The ratio of two sides of a triangle is 5 : 6, and the segments of the base made by a perpendicular falling from the vertical angle on the base are 10 and 14. Find the sides of the triangle.

9. The radius of the base of a cone is 4 feet and the surface of the cone is 113$\frac{1}{7}$ square feet. Find its altitude.

10. A farm was bought for 20 years purchase for \$800, four-fifths of the purchase money remaining on mortgage at 4%. The purchaser had to erect some

fences which cost him $360. This sum he paid in three equal annual instalments (the first instalment on taking possession of the farm). The other annual expenses of the farm were $50. Assuming money worth 8% per annum, what annual percentage did he make on his investment?

XXI.

Edgar Frisby, M.A., Naval Observatory, Washington.

1. Two men, A and B, agree to perform equal pieces of work. A begins one piece, and B the other, and after working 6 days they exchange places. A finishes his piece in 12 days from the time they exchange places, and then returns and helps B; and after working together 2 days they finish his piece. How long would each alone be in finishing either piece?

2. What will be the true interest on $1000 for 6 months, it being supposed that if this interest is invested for the next 6 months that the whole interest for the year shall be exactly 6 per cent.?

3. A railroad train travels for ⅓ of the distance at the rate of 30 miles per hour, the next ⅓ of the distance at the rate of 35 miles per hour, and the remaining distance at the rate of 40 miles per hour. What is the average rate in miles per hour?

4. A person has a note for $100, payable at the end of two years, and another of $50, payable at the end of three years; he is willing to take $135 for them; when should this money be paid so as to allow 6 per cent. compound interest for the money, and what is the present value of the notes?

5. What is the least number of weights, and what are they that will weigh any number of lbs. from 1 up to 9841; and how can 7961 lbs. be weighed with these weights?

6. What is a $1000 6 per cent. bond worth, having 20 years to run, that pays interest 3 per cent. semi-annually, allowing the compound interest on all these semi-annual payments to accumulate until maturity, so that I may realize 5 per cent. per annum on my investment, interest being compounded annually.

7. I buy goods at 25 per cent. below their regular retail selling price; I calculate all the expenses of the establishment, including freight, help, rent, and all incidental expenses, to amount to 25 per cent. on my outlay, and still sell 5 per cent. below the regular retail price, and gain $100 clear profit. How much did I pay for the goods, and how much per cent. did I clear on the whole expenditure?

8. A sold goods which cost $4000 to B at a certain loss per cent., and B sold them to C at the same gaining rate per cent. which was $25 less than A paid. How much did A lose and B gain per cent.?

9. Gold in New York is quoted at 105. How much shall I pay in Toronto for $100 United States Government bond which is quoted in New York at 115, allow $\frac{8}{10}$ per cent. brokerage?

10. I bought goods at 25 per cent. below their real value, which becoming damaged, I sold at 20 per cent. less than they cost me, which was $80 below their real value. What did the goods cost me?

11. How long must I borrow $120, at 8⅓ per cent. simple interest, so that if I pay it back in instalments

of $2, monthly, I can pay it off, including interest, these payments also being calculated at $8\frac{1}{3}$ per cent. simple interest, and the first payment made half a month after I borrowed the money ?

XXII.

JAMES BROWN, M. A.—U. C. COLLEGE.

1. Show that the duodenary scale $\frac{35}{54}=\cdot783$; and find the corresponding vulgar and decimal fractions.

What terminating decimals will terminate when expressed in the duodenary scale. ?

2. Express $529\frac{3}{8}$ in the duodenary scale; and employ that scale to find what length of squared timber, whose cross section is 4 ft. 7 in. by 3 ft. 8 in., will contain $529\frac{3}{8}$ cubic feet.

3. What price per lb. avoird., in English money, is equivalent to 6.43 francs per kilogramme, if 1 franc$=$ $9\frac{3}{4}$*d.*, and 1 gramme$=$15.432 grains ?

4. The pendulums of two clocks beat quarter seconds and are in unison every 5 minutes by the faster one, which gains 6 minutes a week ? What is the rate of the other ?

5. If a cubic foot of water weighs 1000 oz. avoird., and the imperial gallon contains 277·274 cubic inches, how much will 1 lb. of water measure in pints ?

6. Taking the weight of the sovereign to be 123 grains, and its value to be $4·86$\frac{2}{3}$, U. S. gold, and neglecting the value of the alloy, which in English coin is $\frac{1}{12}$ of the weight, and in U. S. coin $\frac{1}{10}$, find the weight of the half eagle.

7. A dealer, who cheats in weight to the extent of one ounce in the pound, gains 12% by selling an article at a certain price, how much would he gain if he gave fair weight?

8. The gross annual rental of a property is \$1800: at what price should it be bought, so that, allowing \$225 per annum for repairs and an insurance on $\frac{5}{8}$ of its cost @ $1\frac{1}{2}$%, the purchaser may receive interest @ 10% per annum on his investment?

9. If a dozen oranges be worth 20 pears and weigh as much as 16, and a bushel of oranges weigh as much as 7 gallons of pears, compare the values of equal measures of the two fruits.

10. A and B, starting from opposite ends, walk over a course a mile long and return without stopping. They meet at 320 yards from B's end and, on their return, at 160 yards from A's starting point. If B started 11 minutes after A, how much later will he get home?

XXIII.

A. Sinclair, M. A.—Windsor High School.

1. Define *Discount*, *Present Worth*, *Interest*, and prove that at Simple Interest the Discount is equal to the present worth of the Interest.

2. The interest on a sum of money for a given rate and time is equal to $\frac{3}{8}$ of the sum, shew that the discount on the same sum for the given rate and time is $\frac{3}{11}$ of the sum.

3. Simple interest at 5 % being allowed; the discount on A's money for 4 years is equal to four times the interest on B's money for 1 year, and the discount for

4 years on A's money and B's money is \$220. Find A's money and B's money.

4. A man by walking 10 hours a day walks from M to N in two days. In coming back he decreases his usual rate by $\frac{1}{5}$ of itself for the first ten miles of his journey, and for the last ten miles he increases his usual rate of walking by $\frac{3}{5}$ of itself, and arrives at M half an hour sooner than he would have done had he travelled at his usual rate. Find the distance between M and N.

5. A cask is partly filled with a mixture of wine and water, the water being $14\frac{2}{7}$ % of the mixture, and the wine is 75 % of the number of gallons which the cask holds. Ten gallons of water are added to the mixture and it is found that the cask is $\frac{15}{16}$ full. Find the number of gallons of wine and of water and the number of gallons which the cask holds.

6. A wholesale merchant buys cloth, paying 10 % duty, and sells it to a retail merchant, gaining 10 % on his money, and the retail merchant sells it gaining $10\frac{90}{121}$ % on his money. But the duty on cloth being abolished and the original price falling 10 %, how should the retail merchant sell cloth which he formerly sold at \$1·34, both merchants making their usual profits.

7. A man has a certain sum of money. He spends \$1000 and then gains \$400, afterwards he spends $\frac{5}{8}$ of what he has and then gains \$800, and after spending $\frac{5}{12}$ of the money then on hand he has \$700 remaining. What had he at first.

8. A man has 400 shares in the Union Trust Company and 800 in the Union Saving Company paying yearly dividends of 4 % and 8 % respectively. Wishing to increase his income he sells out 200 shares in the Union Trust Company and 100 shares in the Union

Saving Company at 50 and 110 respectively, and invests $\frac{1}{4}$ of the money realized in stock, of which the \$60 share paying a yearly dividend at the rate of 10 % was at a premium of \$15 and the rest in the Merchants Bank at 90; what should be the half-yearly dividend from the Bank Stock in order that he may increase his income \$400.

9. A man receives a certain sum of money of which he spends \$5 a day. Ten days after receiving the money he made a bet of $\frac{1}{10}$ of his money and lost, after which he spent \$4 a day. Ten days after making his first bet he made a bet of $\frac{1}{5}$ of the money on hand and gained, and after this spending \$5 a day, his money lasted him 44 days; what sum had he at first?

10. A man buys three casks of wine A, B, C, each containing 64 gallons. His selling price of the wine in A is 10 % above cost, of that in B 20 % above cost, and of that in C 10 % below cost. From each cask 32 gallons are taken out; that from A is poured half into B and half into C; that from B is poured half into C and half into A, and that from C is poured half into A and half in B. From the mixtures in the casks 24 gallons are taken out and the operation repeated. He sells the mixture in each cask and receives for that in A \$182·60, for that in B \$188·20 and for that in C \$192·40. Find the cost price per gallon of the different kinds of wine.

XXIV.

WM. O'CONNOR, M. A.—LONDON HIGH SCHOOL.

1. Prove the rule for reducing a circulating decimal to an equivalent vulgar fraction.

Find the value of $\dfrac{19.5\dot{3}31240\dot{0}-5.1\dot{7}\dot{2}}{7.8\dot{9}\dot{2}+4.\dot{1}+2.\dot{3}5\dot{6}}$.

2. As A can run 11 yards while B runs 10, the former gives the latter a fair start in a course of one mile. After running at their usual rates for 2 minutes, B falls, A being 180 feet behind. How many yards per minute can each run?

3. The compound interest on $567 for two years is $119.07. Find the rate per cent. per annum.

4. A merchant having bought grain at the rate of 5 bushels for $7, loses 455 bushels, and sells the remainder at the rate of 3 bushels for $5. The expenses being $847, and the merchant's net loss $122, find the number of bushels purchased.

5. A bookseller bought a number of books for $180. If he had bought ¼ less for the same money, each book would have cost 50 cents more. He marks them at an advance on cost, but he sells them at 22½ cents less for each book, losing 5 per cent. on cost. Find the number of books and the marked price.

6. A draper bought 240 yards of cloth, five-eighths of which he sold at $25 below, and the remainder at 25 per cent. above cost, gaining $9.25 less than 5 per cent. on the whole transaction. Find the cost per yard.

7. I make 20 per cent by selling 8 parts of green tea with 2 of black, the cost of 6 lbs. of the former being equal to that of 7 lbs. of the latter. In what ratio must I mix them in order that I may gain 30 per cent. without raising the selling price?

8. I invested my capital in mining company stock at 150, and afterwards exchanged one-half the stock at

par for railway stock, paying 6 per cent. annual dividends. The mining company became bankrupt, and I found that my income was $60 less than if I had invested my original capital at 3 per cent. Find the amount of my capital.

9. I lent a sum of money at 4 per cent., and another sum at 5 per cent., the total interest being $68. If I had lent the first sum at 5 per cent., and the second at 4 per cent., the total interest would have been $67. Find the sum lent at each rate.

10. One side of a rectangular field is half as long again as the other, and its area is equal to that of a circle, the circumference of which is $120\sqrt{6(3.1416)}$ yards. Find the cost of fencing the field at 20 cents per foot.

XXV.

W. J. ROBERTSON, M. A. ST. CATHARINES COLLEGIATE INSTITUTE.

1. A trains leaves Toronto for Hamilton, at the rate of 30 miles an hour. During the ¼ part of the journey the speed continues undiminished, after which it stops for 15 minutes, and then continues at ¾ of its former speed. It is found that it takes 2 hours to accomplish the journey. Find the distance between Toronto and Hamilton.

2. A and B engage in business. B manages the business and receives 10% of the profits for so doing. B, on entering puts in 50% more than A; but 6 months after takes out ¾ of what he puts in. At the end of the year A finds that his share of the profit amounts to $1000; giving the total rate of profit to be 30% of the

sum invested. Find B's share of the profit, and the sum invested by each.

3. A merchant commences business with a certain capital. His rate of profit is 20%; but his household expenses are 5% of the sum originally invested. At the end of 3 years he finds himself worth $15,000. How much did he invest?

4. A vessel is insured at ⅞ of its value, and its cargo at its full value. The rate of insurance for the vessel is 3%, and for the cargo 4%. The value of the cargo is 50% that of the vessel. After paying one premium the vessel is lost, and the insurance company loses $16000. How much was the vessel and cargo, respectively, worth?

5. A buys flour to the amount of 500 bbls. He sells ⅓ at 20% advance on cost for cash, and the remainder at 10% advance, giving a credit of 6 months. Given money to be worth 10%, and his cash gain to be $250; find the price of flour per barrel.

6. A banker discounts a note due 6 months hence, charging 8% for accommodation, and finds that at the end of the 6 months, he has made a clear profit of $50. Neglecting days of grace, find the amount on the face of the note.

7. A has stock in the Merchant's Bank to the amount of $200. He finds that after receiving 3 years' dividends at the rate of 8% (payable half-yearly), and selling out at 90, that he has less money by $5 than what he invested. Money being worth 8%, find the price he paid for his stock.

8. An English capitalist sells out of the 3% at 90, and invests the proceeds in Canadian securities at 25% premium, giving a dividend of 8%. He finds that he

has increased his annual income by $10,000. Supposing brokerage to be ⅛% on each transaction, find in £'s sterling the amount of stock he held in the 8%—exchange on London being at a premium of 9¾%.

9. A mortgage of $1000 bearing 6% interest is sold out after one payment of $200 has been made, and after one year's interest is due. The buyer wishes to secure 8% for his money, find how much he must give for the mortgage, the debt still due to be paid off in 4 equal annual instalments.

10. A farmer borrows $5000 from a Loan Company at the nominal rate of 8%. He repays the sum in 5 equal annual instalments of $1400 each. Given money to be worth 10%, find the actual rate the company charges.

XXVI.

ALEXANDER MURRAY, M.A.—GALT COLL. INST.

1. The L. C. M. of two numbers is 100793; the G. C. M. is 17; the difference of the numbers is 1224; find the numbers.

2. A man has $6000 stock in the 4 per cents, which he sells, and invests the proceeds in the 4½ per cents at 88. If the increase in his income be $48, what is the price of the 4 per cents, allowing brokerage in each transaction at ⅛%?

3. An article is sold at a loss of as much per cent. as it is worth in pounds; shew that it cannot be sold for more than £25.

4. A and B engage to do each half of a certain work. A began in the morning half an hour before B. They rested an hour at noon, when half the whole work was

done. B finished his work at 7 p.m., and A his at a quarter to 10 p.m. At what time did A begin?

5. The present income of a railway company would justify a dividend of 6% if there were no preference shares; but as £400,000 of the stock consists of such shares which are guaranteed 7¼% per annum, the ordinary shareholders receive only 5%. Find the amount of the ordinary stock.

6. A cistern is kept constantly supplied with water. Supposing that it is full at first, it is found that 28 equal taps opened together will empty it in 4¼ minutes, and that 21 of the same taps will empty it in 12 minutes; how many taps will be required to empty it in $25\frac{1}{19}$ minutes?

7. Two articles, of which the united cost is $90, are sold each at a gain of as much per cent. as it is worth in $; shew that the sum of the selling prices cannot be less than $130.50.

8. Two clocks strike the hour, and are heard to strike nineteen times; they differ two seconds in time, and the one strikes every 3 seconds, and the other every 4 seconds. When they strike together it cannot be distinguished whether one or both are striking; and this is the case with the last stroke of the faster. What hour do they strike?

9. The population of a county increases in 4 years from 10,000 to 14,641. What is the rate of increase?

10. A field of the form of an equilateral triangle contains just half an acre. What must be the length of a tether fixed at one of its angles, and the other end to the nose of a horse, so as to allow him to graze exactly one-half of it?

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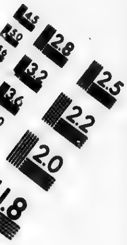
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11. A note for $860 is payable on 1st November; $200 are paid on 1st September; what additional payment ought to be made on 1st October, so as to extend the time for payment of the balance till 1st January?

12. One side of a rectangular figure is 60 feet longer than the other, and its area is equal to that of a square of which the side is 40 ft.; find sides of rectangle.

XXVII.

JOHN CAMERON, B. A.—WINNIPEG P. SCHOOLS.

1. A capitalist holding 5% bonds in a Transportation Co. exchanged them at 64½% for capital stock in the same Co., bearing 7%, at 86%, the int. on bonds and stock having just been paid; his cash gain was $258.33⅓. What amount of bonds did he originally hold, money being worth 6% to him?

2. Suppose that from the time of its capture the rate of increase in value of the marten skins has been uniform find the original cost of 12 bales of these furs, for which at the end of 8 months after being first taken $120 was paid—it being known that the value of 4 bales at the end of six months will support a lodge of 12 Indians for 9 weeks, and the proceeds of 5 bales at the end of 2 months will support a lodge of 35 Indians for 8 weeks.

3. A Hudson Bay trader purchases on commission furs for the storage of which he pays $250; he charges commission at the rate of 2% on 5% advance on total cost of furs, storage, duty, and commission; and duty is paid at ¾% on the total cost of furs, storage, and commission. His commission was $84; find the original cost of the furs.

4. A father leaves his 3 sons, aged respectively 13, 15, and 17 years, $16,000, to be so divided that the shares of the eldest and the youngest placed at compound int. at 5% per annum, will amount to equal sums when they come of age, and be together equal to the share of the other son similarly invested. What rate % is realized by a person who pays $28,561 for the eldest son's share?

5. A Hamilton merchant receives May 21st an ac. sales (due July 5/8) from Winnipeg. He instructs his agent to get the debt cashed at one of the banks and invest the proceeds in a 9-day bill on Toronto. This bill the agent buys on the 27th May at 1½% discount and remits it to Hamilton. It is received there June 2nd and is sold June 8th at ¾% premium; he finds that by doing this he has made $65.23 more than if he had drawn June 8th a draft on Winnipeg, payable July 5th, and sold it at ¾% premium. Supposing the bank discount to be 7%, what was the net proceeds of the ac. sales?

6. A Montana whiskey trader is caught by the Mounted Police, and $2400 worth of furs in his possession, which he had received from the Indians in exchange for "fire water," is confiscated; he is also fined $400, which, however, is just the amount out of which he had cheated the Indians by using a can in the form of a frustum of a cone, one foot in depth, and containing, as he said, 14 imperial gallons, one of the end diameters of the can being ⅗ of the other. Find the diameters.

7. In the Winnipeg Public Schools every time a pupil passes the head of his class he is credited with a "round." Three new pupils A, B, and C, equal in ability and superior to the rest of the class, take their positions at the foot of the class; A had been at three recitations before B entered the class, and when C entered A was 4 times as far as B from the foot towards the head; and when A completed his first "round" he had "got above" as many pupils as the other two, and C had passed one pupil less than four-fifths as many as B. How many pupils were there in the class during this time who did not get a round?

8. Investigate the formula for compound interest, and interpret when n is *negative*.

What is the present worth of an annuity of $1200 in reversion 7 years, and continuing 13 years, at 6%?

9. A farmer wishes to build a rectangular sheep-fold which will contain a quarter of an acre, and which will have an old wall for one side. Find the length and breadth so that it may be built with the smallest possible number of boards.

XXVIII.

E. Tilley, B.A.—Bowmanville High School.

1. Discuss the correctness of the following statement: In order that the denominator of a fraction may be indicated it is necessary and sufficient that the denominator be one of the powers of ten or the difference between two powers of ten.

Write $\frac{68967}{999000}$ with the denominator indicated.

2. A was indebted to B. A failed, and B agreed to take a certain fraction of the debt. The fraction was written as a mixed decimal of two figures, the right hand figure being the larger. The accountant, in making out the bill, by an oversight treated the fraction

as a finite decimal, and hence made an error in the bill of 4*s.* 7*d.* Had the fraction been treated as a pure repetend the error would have been but 2*s.* 6*d.* Find the decimal and the sum B agreed to take from A.

3. A person invested \$5746 in bank stock, and shortly after sold it out for \$5984. Had he bought and sold through an agent at ½ % on each transaction, he would have received but \$5915 on the same outlay. Find the price of the stock, and the quantity bought and sold.

4. The price of pure gold is \$4.29⅙ per oz., the price of a mixture of gold and silver weighing 24 lbs. is \$849.75. If the weight of gold and silver in the mixture be interchanged, the value will be \$444. Find the weight and value of silver in the mixture.

5. Find the present value of a mortgage for \$7200, to be paid in nine equal annual instalments, that the purchaser may realize 8 % per annum on his investment; assuming that the first payment is made at the end of the first year, and that the mortgage bears interest at the rate of 6 % per annum.

6. Two trains started at the same time, one from Toronto and the other from Bowmanville. They met at 9 o'clock a.m. One train reached Bowmanville at 37½ min. after nine, and the other arrived in Toronto at half-past eleven a.m. Supposing the rate of each train to be uniform, and that the distance from Toronto to Bowmanville is 42 miles, find the time of starting and the distance travelled by each train before they met.

7. January 4th, 1876, B had his note for \$600 at 3 mos. cashed by a broker at a discount of 1½ % per mo.

April 4th the note was renewed for a further term of 3 mos. upon the maker paying sundry charges, which amounted to $2.00, and interest at the rate of 2 % per mo. July 4th, B borrowed $600 at 10 % per annum, and redeemed the note. January 4th, 1877, B settled with A in full. Find the rate per cent. per annum that B paid for the use of the money.

8. A sold 1264 yds. of cloth on a note at 9 mos., and immediately discounted the note at the bank at 8 % per annum, and found that the proceeds gave him a net gain of 25 % on his outlay. The banker's gain, not counting days of grace, was $28.44. Find the cost per yard of the cloth.

9. B paid $1,000 to A for some mdse., A realizing a certain rate of gain on the transaction. B sold to C, his rate of gain being twice as great as A's. C sold to D for $1207.50, at a rate of gain three times as large as B's. Find A's and C's buying prices, and the rate per cent. of gain made by each.

10. A person having to pay $2040 two years hence, invested a certain sum in the 7½ % stocks to accumulate interest until the debt be paid, and an equal sum the next year. Supposing the investments to be made when the stock is at 112½, and the price of the stock to remain the same, what must be the sum invested on each occasion, that there may be just sufficient to pay the debt at the end of the time?

XXIX.

J. MORRISON, M.B., M.A.—NEWMARKET HIGH SCHOOL.

1. The difference between the interest and the dis-

count on a certain sum for 8 months at 6 % is \$0.08$\frac{4}{13}$. What is the sum?

2. A person invests in the Grand Trunk Railway 3 per cents, so as to obtain 3¼ per cent. clear on his investment when there is an income tax of 2½ cents in the dollar, the brokerage being ⅛ per cent. At what price must he buy?

3. A person sells out \$4600 stock in the 4 per cents at 92; and invests in the 3½ per cents, gaining thereby \$40 per annum by the change of income. At what price did he purchase the latter stock?

4. A and B together earn as much in 30 days as A does alone in 42 days. In what time would B alone earn the same sum?

5. A person invests ⅖ of his capital in the Toronto Bank stock, ⅜ in Great Western Railway stock, and the remainder in Newmarket debentures. He sells the bank stock at a profit of 5 per cent. the Railway stock at a profit of 4 %, and the debentures at a loss of 2 per cent. and realizes \$5130. What was the amount of his property originally?

6. A person sells out \$5000 stock of the 3 per cents at 96 and invests the proceeds in bank stock at 75, which pays an annual dividend of 2½ per cent. What is his increase of income?

7. The Earth, Venus, and the Sun were observed to occupy the same relative positions after an interval of 583·921 mean solar days. The Earth performs one absolute revolution round the Sun in 365·256 days. Find the periodic time of Venus.

8. The Moon's mean siderial period is 27 days 7

hours 48 minutes 11 seconds. Find her mean synodical period, or the mean duration of the interval from new moon to new moon.

9. A solar spot was observed to pass from the eastern to the western limb of the Sun in 18$\frac{5}{8}$ days. Determine the time of the Sun's rotation on his axis, supposing, of course, that the spot has no proper motion of its own, and that the Earth performs one revolution round him in the same direction in 365·256 days.

10. The intensity of gravity varies directly as the mass or quantity of matter and inversely as the square of the distance from the centre of attraction. The Sun's mass is 314760, the Earth's being 1; and his diameter 852584 miles, that of the Earth being 7920 miles. Find what a pound of terrestrial matter would weight at the Sun's surface.

XXX.

C. A. Barnes, Esq., Strathroy, P. S.

1. A farm is rated at 60 cents per acre, and the tenant on receiving back 10% of his rent found the sum returned amounted to $24 more than the whole rate. The next year the rate was doubled, and he received back 15% of his rent, but found that the sum returned only just paid for the whole rate. Required the rent, rate and number of acres.

2. A and B with despatches between two towns start at the same time, and meet when A has travelled 30 miles more than B, and they afterwards reach their

destination in 4 and 9 hours respectively. What was their rate of travelling and distance between the towns?

3. Two clocks are striking the hour together, and they are heard to strike 19 times. There is a difference of 2 seconds in their time, and the faster strikes every three, and the other every four seconds. What is the hour they strike, it being observed that when the clocks strike in the same second the sounds cannot be distinguished so as to determine whether one or both strike in that second, and that is the case with the last stroke of the faster clock?

4. An agent in Cuba wishes to remit $4,000 to his employer in France. Which will be more advantageous, after deducting the expenses of exchange, to remit indirectly through New York or directly by a bill on Paris, provided one dollar Cuba currency be equal to 5 francs, and the exchange of Cuba on Paris be 1% premium, of Cuba on New York 4% premium, and of New York on Paris $5\frac{3}{10}$ francs per dollar. The agents in Cuba and New York each receive ½% commission for doing the business.

5. A, B and C enter partnership; A contributes $12,000 for 6 months, B a certain sum for 9 months, and C $9000 for a certain time. The gain is $5,400, of which A takes $\frac{4}{15}$ and B $500 more than 80% of a sum which is greater than A's and C's by $50, and C the remainder. Find B's stock and C's time.

6. Find what A, B, C, D are worth, by knowing— 1st. That A's money, together with ⅓ of B, C, D, is equal to $137. 2nd. That B's money, together with ¼ of A, C, D is equal to $137. 3rd. That C's money, together with ⅕ of A, B, D is equal to $137. 4th. That

D's money, together with ⅓ of A, B, C, is equal to $137.

7. Supposing the elastic power of a ball which falls from a height of 100 feet to be such as to cause it to rise 50 feet, or one-half the height from which it fell, and to coutinue in this way diminishing the height to which it will rise in geometrical progression till it come to a state of rest, how far will it have moved and in what time from starting?

8. If several partners advance respectively capitals C_1, C_2, C_3, C_4, &c., during the time t_1, t_2, t_3, t_4, &c., respectively, show that their gain or loss are proportional to the products $C_1 t_1$, $C_2 t_2$, $C_3 t_3$, $C_4 t_4$, &c.

9. A man owes a sum of money, which it is agreed he shall pay in 5 instalments equal in their time and amount; and with each instalment he is also to pay interest at 5 per cent. on the amount *then* owing. The last payment at the expiration of 12 months being (with interest) $28, it is required to know the original amount of debt, and the time and amount of each payment.

10. Three circles whose radii are as the numbers 6, 7, 8, are inscribed in a circle whose diameter is 336 feet. Required the radii of the inscribed circle.

XXXI.

I. J. Birchard, Esq., Toronto, P. S.

1. In reducing to a decimal the proper fraction $\frac{a}{b}$, b being prime to ten, shew that when the remainder $b-a$ occurs half the circulating period has been obtained, and how the remaining figures may be found. Shew also that the period itself is divisible by 9.

2. What is meant by "Scales of Notation"? When a fraction is reduced to a decimal in any particular scale, how can you previously determine the nature of the resulting decimal?

In a certain scale, radix less than ten, the fractions $\frac{11}{63}$ and $\frac{1}{40}$ give respectively two and three finite places of decimals; in the same scale would $\frac{1}{35}$ give *any* finite places?

Shew that the fraction $\dfrac{1}{m^2}$ cannot give more than $\dfrac{1}{(m-1)^2}$ places which repeat.

3. Shew that the difference between the amount of the present worth of a note discounted by the Bank and the face of the note is proportional to the square of the product of the time and rate.

The difference between the true and the bank discount of a note for $315, payable in one year, is 75 cents. Find the rate.

4. The number of teachers and pupils in the Toronto Public Schools in 1877 were respectively $33\frac{1}{3}\%$ and 10% more than in 1876, and the number of teachers and pupils together $10\frac{70}{273}\%$ more than in 1876. Had 10 fewer teachers been engaged, there would have been 9 less pupils per teacher than in 1876. How many new teachers were engaged?

5. A grocer uses to his advantage a false balance in both buying and selling, and gains altogether $46\frac{41}{100}\%$. Had he used the scales to his disadvantage in both buying and selling he would have neither gained nor lost. How many oz. did he give for a pound, and what was his gain per cent.?

6. A young man enters upon a situation at a salary of $100 per quarter, which is increased $10 every payment. His expenses are $75 for the first quarter, and increase 5% each succeeding quarter. After each payment he deposits his spare money in the bank, for which he receives 6% per annum interest; what will he be worth in 10 years? Give the result in surd form and approximate its value, taking $(1.05)^{40}=7.04$, $(1.06)^{10}=1.79085$, $(1.06)^{\frac{1}{4}}=1.014674$. At the above rate would his expenses ever equal his salary? Why?

7. A merchant invests $12,000, which yields 25% annually. At the end of the first year he withdraws $1000 for expenses, and each succeeding year $33\frac{1}{3}$% more than the preceding year. When will he be ruined? When had he better close his business? What will he then be worth? Log. 2=.3010300. Log. 3=·4771213.

8. A boatman can begin to row at the rate of 5 miles per hour in still water, but his speed uniformly diminishes one-half mile per hour; he can row down stream to a certain point in an hour, and return in two hours; find the rate of the stream.

9. A C B is a semicircle. C a point on the circumference, such that A C is 3 feet and B C 4 feet. On A C and B C semicircles are described so as to fall without A C B; find *precisely* the sum of the areas of the two lunes thus formed. Could you thus find the exact area of a circle?

10. Squares are described on the sides of a triangle so as to fall without it, and the exterior angles of the squares are joined so as to form a polygon without any re-entrant angles; shew that the sum of the squares on these three lines is equal to three times the sum of the squares on the sides of the triangle. Show also

that the sum of the three triangles formed by joining the exterior angles of the squares is equal to three times the original triangle.

XXXII.

Miss Corner, Toronto.

1. A and C can do a piece of work in 3 days, which B and C can do in 5, and A and B in 4 days. They work $2\frac{26}{47}$ days. Had B working alone been able to finish it $\frac{1}{7}$ of a day sooner, he would have received $2 more than he did. Find the sum of money required to pay A, B and C their wages.

2. I remit my agent in New York $64960, with instructions to deduct his commission at $1\frac{1}{2}$ %, and invest balance in sugar. In addition, I have to pay freight $1740, insurance $900, and an *ad valorem* of $2\frac{1}{4}$ % on the invoice price of the sugar. He sells the sugar at a profit of $1\frac{407}{863}$ % on the whole outlay, but instead of receiving cash he receives a note @ 70 days, which on being discounted at the bank at 5 % exactly settles the claim. Required face of note and amount invested in sugar.

3. A started in business. 16 mos. after he commenced, B entered as a partner with a capital equal to $\cdot\dot{1}4285\dot{7}$ of A's. 2 mos. later C entered, and his capital was to B's as B's time was to A's time. At the end of four years from time of starting they agreed to wind up affairs; D assumed charge, and settled the claims of the partners by making over to them a mortgage for 10 years on the full value of an estate worth annually $9700. What is the P. W. of B's claim, supposing compound interest be allowed at 5 %; the partners sharing according to their stocks and time in trade ?

4. Interest and discount may both be considered as interest on a certain sum. Explain.

A merchant being asked his original capital, replied that three years after starting he had been worth \$4374·616, and that he had added annually to his business a sum equal to his original capital, increased by compound interest at the same rate that he had had a note of \$1,120 for 2 years discounted at, receiving \$120 as discount. What was the merchant's original capital?

5. A bought 100 lbs. of each of two kinds of tea, the price of the dearer being to the price of the cheaper as 11 : 9. He mixed 15 lbs. of the dearer with a certain amount of the cheaper, and sold it without loss at 95c. per lb. The remainder of the dearer tea he marked at \$1.54 per lb., thereby clearing $\frac{2}{5}$ of the cost price, but sold it 2c per lb. dearer. Required gain % in the latter case, and the number of lbs. of the cheaper that he mixed with the 15 lbs. of the dearer.

6. A man in England owns £400 in Bank of England 4 % selling at 104½. He sells through a broker, who charges ½ % commission for each transaction, when exchange is at 110 and invests. in Dom. 6 %. How much can he afford to pay for latter, in order that his income may neither be increased nor diminished?

7. A man finds by his watch that he can row a certain distance *down* a stream, running ordinarily at the rate ¼ of a mile an hour, in 56′, and *up* in 1 hour. He discovers, however, that his watch gains 2′ daily. Find the difference between the real distance that he rowed, and the distance ascertained from his watch time, supposing the watch to show correct time at starting.

8. Deduce a method for finding the *time* when principal, amount, and rate % are given compound interest.

A farm annually increases in value 20 %, in what time will it be worth 3 times its original value? Log. 2=·301030. Log. 3=·477121.

9. A merchant buys 100 yds. of cotton at 10c per yd., and 80 yds. at 7½c per yd., on 6 mos. credit, choosing to purchase in that way rather than to receive a certain discount for cash. He sold the former at a profit of 12 % on the *cash* buying price, and the latter at a profit of 20 %; had he reversed the proceeding he would have gained 30c more than he did. Required the rate % of discount which the merchant might have received by purchasing for cash.

10. A field in the form of a parallelogram has a tree planted in the centre. Adjacent sides 14 and 9 per. respectively. Shortest distance from corner to corner across field 8 per. Required distance from tree to farthest corner of field.

XXXIII.

C. Moses, Esq., P. S. I., Haldimand.

1. Two lbs. of tea and 6 lbs. of sugar cost $2.40, but if sugar were to rise 50% and tea 10% they would cost $2.80; find the price per lb. of tea and sugar.

2. My agent in Montreal sold a consignment of flour on a commission of 3%, and invested the proceeds in U. S. 6's 5-20 at 95 on a commission of 2% on the amount invested, his whole commission is $530; what is my income on said investment?

3. A goldsmith has two defaced ornaments, the first containing 1⅖ ozs. of gold and ⅗ of an oz. of alloy, the

second containing $\frac{4}{5}$ of an oz. of gold and $1\frac{1}{5}$ ozs. alloy; how much must he take from each to form a new ornament weighing 2 ozs., containing equal parts of gold and alloy?

4. A mortgage of $1000, repayable in 5 years at $200 a year with interest at 6% on the unpaid principal, is sold; what is its value allowing the purchaser 8% for his money.

5. A dishonest broker, having a certain number of old sovereigns, reduced each by $\frac{1}{12}$ of its value and passed $\frac{7}{8}$ of them thus gaining £1 2*s.* 9*d.* In attempting to pass the remainder, he was arrested and the sovereigns taken from him with the exception of one which he managed to conceal. How many sovereigns were there and what was the value of each, it being known that the man gained 4*s.* $10\frac{1}{2}$*d.* on the whole transaction?

6. A owes B $1200 due in 4 months which B offers to discount at 12% per annum. Now A finds that for 2% he can get the use of D's name with which he can get the note discounted at the bank for 8%; which will be the better way and by how much?

7. An express train leaves Fort Erie for Caledonia at 1 o'clock p. m., at the rate of 30 miles per hour, and 15 minutes after is followed by a freight train at the rate of 20 miles per hour. A mixed train leaves Caledonia for Fort Erie at the rate of 25 miles an hour, and after travelling 1 hour meets the express and in 20 minutes afterwards meets the freight train. At what time did the mixed train leave Caledonia?

8. A merchant in Montreal imported from England a quantity of goods for which he had to pay a duty of 15%. On account of the depression in trade he is forced

to sell at a loss of $5\frac{5}{7}$%; had he sold them a month earlier he would have made $496.80 more than he did and then would have cleared $2\frac{6}{7}$% on the transaction; what price did he pay for the goods?

9. A statue 80 feet high stands on a pedestal 50 feet high, and to a spectator on a horizontal plane, they subtend equal angles; required the distance of the observer from the base, the height of the eye being 5 feet.

10. The sides of a triangle are 8, 10 and 12 respectively; find the difference between the diameters of the inscribed and circumscribed circle.

XXXIV.

JAMES CARLYLE, M.D.—NORMAL SCHOOL, TORONTO.

1. The annual income from an estate is the rent and the income tax which is levied on the rent after it is reduced 20%. If the annual income be $3175, and the income tax 2 cents on the $, what is the taxable income?

2. A broker receives instructions to purchase Montreal Bank stock, that pays 7% half-yearly dividends, so that 4% may be realized on the investment. What may he pay for the stock if bought two months before the dividend is payable.

3. On January 1st, 1877, B purchased a farm for which he gave a bond securing the payment of $5000, in 10 annual instalments of $500. B paid nothing until January, 1879, when he took up the bond, paying 7% interest on overdue instalments, and being allowed 7% discount for all not due. Required the amount B paid.

4. A owes B $520, due in 6 mos., $648 in 12 mos., $4704 in 18 mos., and $1200 in $2\frac{1}{4}$ years. If money be worth 8% simple interest, find when it would be fair to both parties for A to pay his whole indebtedness.

5. If 5 men, 4 boys and 8 girls, can clear a meadow of stones in 9 days, or 8 men, 8 boys and 6 girls can do it in 8 days, or 4 men, 10 boys and 9 girls can do it in 6 days, how long will it take 8 men, 5 boys and 4 girls to clear it ?

6. If the population of Canada is now 3,750,000, and the increase from all sources annually is $\frac{1}{8}$ of the population at the beginning of the year, and the decrease $\frac{1}{12}$, find how long it will be before the population is 10,000,000. Given log. 2 = ·301030 and log. 3 = ·477121.

7. A person has the offer of $1500 a year for 15 years, or by waiting 15 years, to enjoy the annuity as a perpetuity. Determine the conditions that will render one better than the other.

8. A owns a mortgage securing the payment of $1200 in three annual instalments of $400, with interest at 8%. He exchanges it for bank stock that pays 16% dividends, at 177$\frac{1}{3}$. Find the amount of stock he received.

9. A dealer bought wheat at $1.75, $1.80 and $2. In what proportions may they be mixed so as to sell the mixture at 2.15\frac{1}{4}$ on 8 mos. credit, when money is worth 10%, and make a present gain of 12% ?

10. A speculator in Toronto purchased $100,000 Bank stock in New Orleans at 80, and sent a draft to his broker in New York, with instructions to settle for the stock. Exchange between Toronto and New York 1$\frac{1}{8}$% premium, between N. Y. and N. O. $\frac{3}{4}$% discount. Brokers charge $\frac{1}{4}$% on amount transmitted to N. O. Find what the stock cost the speculator.

JULY EXAMINATIONS, 1877.

Second Class Teachers and Intermediate.

1. Prove the rule for reducing a mixed circulating decimal to an equivalent vulgar fraction.

Find *accurately* what fraction [illegible] of ($\frac{7}{8}$—.512) of $3.6\frac{57}{128}$ ac., is of $2\cdot\dot{6}6260\dot{1}$ acres.

2. Shew how to find the L. C. M. of two or more numbers.

Find the L. C. M. of 483 bushels, 472 bushels 2 pecks; 258 bushels, 3 pecks.

3. A merchant buys flannel at 32 cents per yard; at what profit per cent. must he sell it in order that the money he receives for 220 yards, may be equal to his gain on $480 of outlay?

4. Three watches hang side by side, and all show 12 o'clock at the time of observation; the first is known to gain 10 minutes, and the second to lose 10 minutes in 12 hours, while the third keeps accurate time. When will all the *minute* hands be next at 12 together?

5. How many ounces of coinage gold are equal in value to 112 ounces of coinage silver, 1869 sovereigns weighing 40lb troy, and 66 shillings weighing 1lb troy?

6. Distinguish between bank discount and true discount? If the simple interest on a sum of money for a given time and rate is $\frac{1}{n}$ of the sum itself, show that the true discount is $\frac{1}{n+1}$ of that sum.

7. Reckoning commercial discount at 5 per cent, a person would receive $44.52 less than the nominal value of a note which has a year to run; what should he receive for the note if true discount only were deducted?

8. What must a person have invested in Bank of Commerce Stock at 120, and paying 4 per cent. half yearly dividends, if a transfer of 65 per cent. of his capital to Dominion Bank Stock at 180, and paying 4½ per cent. half-yearly dividends, makes a difference of $5 in his semi-annual income?

9. A merchant in Montreal drew on Hamburg for 6000 guilders, at $.415; how much more would he have received if he had ordered remittance through London to Montreal, exchange at Hamburg on London, being 11¼ guilders for £1, and at London on Montreal, 9¼ %, brokerage being 1¼ % for remitting from London?

10. The length of an iron cylindrical vessel with closed ends is 8 feet, and its outside circumference is 36 inches, the metal being an inch in thickness. Find its weight when filled with water, iron being 7⅕ times heavier than water, and water 62½ lbs. per cubic foot.

SECOND-CLASS TEACHERS AND INTERMEDIATE.

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1. Simplify $\dfrac{\frac{1}{3} + \frac{1}{5} + \frac{1}{7}}{\dfrac{1}{2\frac{1}{3}} + \dfrac{1}{3\frac{1}{5}} + \dfrac{1}{4\frac{1}{7}}} \times \frac{11}{12}$ of $7\frac{1}{3}$, and

Reduce 8 oz. 6dwt. $3\frac{8}{13}$ grs. to the fraction of a lb. troy.

2. Divide, to 6 decimal places, nine million eight hundred and forty thousand and eighteen 10-millionths, by one hundred and fifty-nine thousand nine hundred and eighty-two 100-millionths.

3. What will it cost to purchase bricks for a wall 150 feet long, 6 feet high, and 18 inches thick, bricks being worth $6.25 per thousand, and each brick being (including mortar) 9 inches long, $4\frac{1}{2}$ inches wide, and 3 inches thick?

4. "Toronto, December 1st, 1876.—For value received I promise to pay A. B. $1500 one year after date, with interest at eight per cent. per annum." This note is endorsed as follows:—January 23, 1877, $400; August 20, 1877, $500. Find the amount required to pay the note when due (no days of grace).

5. Explain the terms—Stocks, Shares, Dividends. When is stock at par? At a premium? At a discount?

A man having $25000 Dominion Bank Stock paying eight per cent. per annum, sells out at 120 and invests in Bank of Commerce stock, which is at 125, and pays eight and one-half per cent. Find the alteration in his income.

6. How much sugar at 8 cents, 9 cents, 10 cents, 13 cents, and 14 cents per pound, must be taken to form a mixture of 400 lbs., worth 12 cents per pound?

7. A coin whose weight is [illegible] of an ounce contains 37 parts in 40 of gold, and the rest is silver; gold being worth $17 per ounce, and silver worth $1.10 per ounce, find the value of the coin.

8. If at Toronto sterling exchange is quoted at $10\frac{1}{4}$, and at Liverpool exchange on Paris is 26 francs 85 centimes per £1, find what a Toronto merchant, remitting through Liverpool, must pay to discharge a debt of 12,000 francs (brokerage included in the above quotations).

9. If the diameter of a twenty-cent piece be to that of a twenty-five-cent piece as 10 to 11, find the ratio of their thicknesses.

10. Two trains respectively 99 yds. and 132 yds. long, and moving on parallel rails, pass each other in $6\frac{3}{4}$ seconds when running in opposite directions; when moving in the same direction the one passes the other in $47\frac{1}{4}$ seconds. Find their rates per hour.

JULY EXAMINATIONS, 1877.

THIRD CLASS TEACHERS.

1. If 69 German Thalers, of which 9 parts in 10 are fine silver, weigh 41 ounces, what is the value of a Thaler in English money when standard silver, of which 37 parts in 40 are fine, is worth 5*s*. 1½*d*. per ounce?

2. A, B, and C can do a piece of work in 2 days, A and C in

$$6\left(\frac{7\frac{1}{3}\text{ of }12\frac{3}{8}}{2\frac{3}{8}\text{ of }15\frac{1}{8}}\right)-3\left(\frac{2\frac{1}{4}\text{ of }4\frac{1}{3}}{2\frac{1}{14}\text{ of }2\frac{1}{3}}\right)\text{ days;}$$

in what time can B do it alone.

3. A certain kind of brass is made by fusing together old brass, refined copper, and zinc, in the proportion of 33, 35, and 24; how much of each must be taken to produce 170 lbs. of brass, after allowing 2⅓ per cent. for waste?

4. March 21st, 1877; sterling exchange is quoted at 9¾ for demand bills; what must be paid for a demand bill for £18 5*s*.?

5. What will be the cost of insuring a ship worth $48628¼, at 3½ per cent., so that in case of loss the owner may recover the value of the ship, and the amount paid for insurance?

6. The numerator of a certain fraction is a fifth as much again as its denominator, and the sum of the numerator and denominator is 352. Find the fraction?

7. A room whose height is 12 feet, and length 1¼ times its width, takes 178⅔ yards of paper 1 ft. 9 in. wide to cover its walls; what will it cost to cover the floor with carpet 27 in. wide and costing $1.75 a yard?

8. The L. C. M. of two numbers is 634938944494, and their G. C. M. is 9187: one of the numbers is 85044059; find the other.

9. The difference between the interest and the discount of a sum of money for 1 year and 9 months, at 8 per cent., is $9.80; find the sum.

10. A rectangular field whose length is three times its breadth, contains 6 acres 900 yards: find its length and breadth.

JULY EXAMINATIONS, 1877.

FIRST-CLASS TEACHERS.

1. Define and investigate methods of finding the G. C. M., and the L. C. M. of two or more fractional numbers.

Three watches hang side by side and all show 12 o'clock at the time of observation; the first is known to gain 10 minutes, and the second to lose 10 minutes in 12 hours, while the third keeps accurate time. In what time will *all* the hands first be at 12 together?

2. A grocer bought a quantity of tea at 40 cents per lb., and fixed a price on it, to gain 23$\frac{1}{11}$ per cent., but in selling it he in-

advertently used a pound weight which was $\frac{3}{4}$ oz. too light, thus gaining $31.20 more than he would have gained if the weight had been true. How much did he buy?

3. Show that if the true discount of a sum of money for a given time and rate be $\frac{a}{b}$ of that sum, then the interest would be $\left(\frac{a}{b-a}\right)$

(1) The interest on a certain sum for 6 years is $261, and the discount for the same time is $180. Find the sum and the rate per cent.

(2) The interest on a certain sum is $180, and the discount for the same time and rate is $150. Find the sum.

4. How much U. S. currency will be required to purchase U. S. 6 per cent. bonds, interest payable in gold, to give an income of $1,113 in currency, gold being at 106, and the broker's commission $\frac{1}{8}$ per cent. on the par value of the bonds?

5. I bought a quantity of tea from Thwaite, Eby & Co., Toronto, who allowed me a discount of 4 per cent. on the price charged for the tea and accepted for the reduced amount my note payable in 6 months; I sold the tea at once for a note of $510.51 payable in 3 months, and allowing money to be worth 8 per cent. per annum, I found I had made a profit of 18$\frac{6}{11}$ per cent. Find the price first charged for the tea.

6. From 2 lbs. of standard gold are coined 89 guineas, and from 1 lb. standard silver 66 shillings, 8$\frac{1}{3}$ per cent. of standard gold being alloy, and 7$\frac{1}{2}$ per cent. of standard silver. If 24 pennies are coined from 1 lb. avoirdupois, calculate the ratio of the values of gold and copper.

7. Find the compound interest on $4000 at 10 per cent. for 3$\frac{1}{2}$ years (payable yearly).

8. A man invested a certain sum in Bank of Commerce Stock at 125 and paying 4$\frac{1}{2}$ per cent. half-yearly dividends; 44 per cent. *more* than that sum in Dominion Bank Stock at 135 and paying 4$\frac{1}{2}$ per cent. half-yearly dividends; and 39$\frac{1}{4}$ per cent. *less* than that sum in Consolidated Bank Stock at 95, and paying 3$\frac{1}{2}$ per cent. half-yearly dividends; his half-yearly income from the second investment was $12.75 less than from the other two together. Find the amount invested in each kind of Stock.

9. To do a certain piece of work, for which $120 is paid, *B* would take 2$\frac{2}{3}$ times as long as *A* and *C* together, *C* 4$\frac{1}{2}$ times as long as *A* and *B* together, and all three working together actually do the work in 2$\frac{2}{3}$ days. Divide fairly among them the money paid for the work.

10. (1) The base of an equilateral triangle falls on the diameter of a semicircular arc, and its vertex is in the middle point of the arc; the length of a side of the triangle being 8 feet, find the diameter of the circle.

(2) The town *A* is 30 miles from *B*, *B* 25 miles from *C*, and *C* 20 miles from *A*; find where a house must be erected to be equally distant from *A*, *B*, and *C*.

JULY EXAMINATIONS, 1878.

SECOND CLASS TEACHERS AND INTERMEDIATE.

1. From 78004 take 29073, explaining clearly every step of the process.

Multiply 5931 by 427, and then divide the product by 5931, showing that the latter process is the converse of the former.

2. What is a *composite number?* a *prime number?* When are two numbers *prime to each other?*

Of all the numbers, besides unity, that may be subtracted from 18445 an exact number of times, which may be taken the *greatest*, and which the *least* number of times?

3. Show that the value of a fraction is not altered by multiplying both terms by the same number.

Simplify $\dfrac{\sqrt[3]{5.12} + \sqrt[3]{0.03375}}{\sqrt[3]{80} - \sqrt[3]{0.01}}$

4. A room is 24 ft. 6 in. long, 18 ft. 3 in. wide, and 11 ft. 9 in. high, how many yards of paper 27 inches wide would be required to cover its walls?

5. If 2 lbs. of tea were worth 3 lbs. of coffee, and 4 lbs. of coffee worth 21 lbs. of cocoa, and 7 lbs. of cocoa worth 9 lbs. of sugar, and 20 lbs. of sugar worth 4⅜ lbs. of raisins, how many lbs. of raisins would be worth 30 lbs. of tea?

6. A person discounts a note due in 15 months, so as to make 10 per cent. per annum on his money, what rate per cent. on the face of the note does he exact?

7. Extract the square root of six million seven hundred and eighty thousand eight hundred and sixteen ten-billionths.

An estate which has been surveyed is 400,000,000 times as large as the map of it which has been made; express the linear scale of the map in terms of an inch to a mile.

8. A rectangular solid 10 ft. long and 8 ft. broad weighs 4½ tons, and a cubic inch of the same material weighs 2 oz.; find the depth of the solid.

9. A certain metal weighs 480 lbs per cubic foot, and is worth $50.40 per ton (2000 lbs.), what will be the cost of a quantity of the metal sufficient to make a mile of piping of 9-inch bore and [illegible] of an inch thick? (Use 3⅐ as ratio of the circumference of a circle to its diameter).

10. Two circular plates of gold, each an inch thick, the diameters of which are 9 inches and 12 inches respectively, are melted into a single plate ½ an inch in thickness. Find its diameter.

JULY EXAMINATIONS, 1878.

FIRST-CLASS TEACHERS.

1. Show that if a number be divided by 9 it leaves the same remainder as the sum of its digits divided by 9.

Multiply 643287 by 462427 in the shortest way you can.

2. Prove: [illegible] of 1 = [illegible] of 3 ; $\frac{2}{3}\times\frac{4}{5}=\frac{2\times4}{3\times5}$; $\frac{2}{5}\div\frac{3}{4}=\frac{2\times4}{5\times3}$

Simplify $\left(\frac{£7\ 5s}{£14\ 7s}-\frac{2\text{tons } 2\text{qrs. } 26\text{lb.}}{4\text{tons } 1\text{qr. } 21\text{lb.}}\right)\div\frac{4\frac{1}{2}}{[illegible]-[illegible]-[illegible]}$

3. Show that a vulgar fraction whose denominator is of th form $2^m\times5^n$ is reducible to a finite decimal having m or n place of decimals according as m or n is the greater.

4. A person travelled from London to Loch Lomond (48 miles) by sea, rail and coach. The distance by coach was [illegible] that by rail, and the distance by rail .15 that by sea; the cost of the travel by coach was [illegible] that by rail, and the cost by rail was [illegible] that by sea: coach fare being 8 cents a mile, find the cost of the entire journey.

5. A man invested .62 of his money in bank stock at 124 paying 8½ per cent. dividends, and the remainder in railway stock at 95 paying 6 per cent. dividends; his income from both sources was $1270: find the amount of each investment.

6. I sold a quantity of Consolidated Bank stock at 105, and invested in railway stock at 95; the railway stock having risen to 98 I sold out, and reinvesting the proceeds in Consolidated Bank stock at 105, found I had gained $300 stock. How much Bank stock had I at first?

7. A decimetre is equivalent to 3.937 inches, and a cubic decimetre of water weighs one kilogramme; if a cubic inch of water weighs 252.45 grains, express a kilogramme in pounds (avoirdupois) correct to within one-thousandeth part of a pound.

8. A retailer marks his goods at three prices, a cash price, a six months' credit price, and a twelve months' credit price; from his twelve months' prices he deducts 12½ per cent. for cash, and 7½ per cent. for six months' credit. His six months' prices are 40 per cent. in advance of the cost price of the goods. Find at how much advance on cost he sells on twelve months' credit, goods which sell for $6.66 cash.

9. A youth on coming into his fortune at the age of 21 invests in a Bank which allows 5 per cent. per annum interest. At the end of each year he withdraws for his expenses a sum equal to [illegible] of his first year's interest: show that if he lives to the age of 83 he will be penniless; given, log 2=.30103, log 3=.47712, log 7=.84510.

10. (1) A hill is to be cut through for a line of railway; a vertical section of it would be an isosceles triangle of height 150 feet and vertical angle 120°. Determine the number of cubic yards of soil to be removed in making a horizontal cutting, supposing the railway to be 40 feet wide, and the sides of the cutting to be perpendicular.

(2) The area of a square field is 9 acres 3 roods 8.16 poles. A path 3.9 yards wide is constructed round the sides at a cost of 8 cents per square yard, and the remainder of the field is laid down in turf at a cost of 15 cents per square yard: find the total cost of preparing the field.

JULY EXAMINATIONS, 1878.

THIRD CLASS TEACHERS.

1. Distinguish the terms *multiple*, *common multiple*, and *least common multiple*.

The l.c.m. of 891 and another number is 12121, and the g.c.m. is 23: find the other number.

2. Prove that $2\frac{1}{4}+\frac{9}{5}$ is equal to $2\frac{1}{4}\times\frac{9}{5}$.

Simplify $\dfrac{1\frac{7}{9}+8\frac{1}{4}}{7\frac{5}{6}-4\frac{2}{9}}\div\dfrac{2\frac{1}{10}+\frac{7}{35}}{\frac{7}{35}-\frac{7}{76}}\times\dfrac{45\frac{1}{6}}{21\frac{1}{4}}$

3. Divide to 6 decimal places nine million eight hundred and forty thousand and eighteen ten-millions by one hundred and fifty-nine thousand nine hundred and eighty-two hundred-millionths.

4. Define ratio and proportion. Show that when four quantities are in proportion, the product of the extremes is equal to the product of the means.

Find a fourth proportional to 767 acres 9 chains 279 yards 4 feet, 208 sq. miles 181 acres 93 yards 4 feet, $1317.

5. Find the ratio of the simple interest to the true discount on a sum of money for a given time and rate.

The interest on a sum of money is $110, and the discount for the same time and rate is $88: find the sum.

6. How many bricks, 9 inches long, 4½ inches broad, and 4 inches thick, will be required for a wall 60 feet long, 17 feet high, and 4 feet thick, allowing that the mortar increases the bulk of each brick 6½ per cent.

7. What is the square of a number? The square root?

The square of 10129 is 102596641, find the square of 101293 without going through the operation of squaring.

Extract the square root of .047619+1.190476.

8. A man rows three miles down stream in 40 minutes; without the aid of the stream it would take him an hour: how long would it take him to return against the stream?

9. A grocer bought a quantity of tea of a certain quality, and one-fourth as much of an inferior kind, the cost of the latter, per pound, being only 80 per cent. of that of the former; he mixes them, and sells the mixture at an advance of 10 per cent. on the cost, per pound, of the finer quality: find his entire gain per cent.

10. A man invests a certain sum of money in railway stock selling at 80 and paying 5 per cent. dividends, and 50 per cent. more than that sum in Bank of Commerce stock selling at 120 and paying 8 per cent.; his income from both investments is $520: find the amount invested in each kind of stock.

DECEMBER EXAMINATIONS, 1878.

SECOND CLASS TEACHERS AND INTERMEDIATE.

1. Show that [illegible] of 1 = [illegible] of 4.

Simplify

$$\left\{\frac{1}{2}\left(\frac{4\,\text{[illegible]}\ \text{of}\ 6\frac{2}{3}}{7\,\text{[illegible]}}\right)+\frac{8\,\text{[illegible]}+2\frac{1}{6}}{3\,\text{[illegible]}-8\,\text{[illegible]}}\right\}\ \text{of}\ £182\ 7s.\ 5d.$$

2. Prove the principle on which the rule for finding the G. C. M. of two quantities depends.

Find the G. C. M. of 169087 and 66429, and the L. C. M. of 44, 48, 52, 96.

Define Ratio. Show how to find a fourth proportional to three given numbers.

A grocer has 224 lbs. of a mixture of chicory and coffee, the chicory being to the coffee as 1 : 6 ; what amount of chicory must be added to make the ratio 1 : 5 ?

4. A cistern (no lid) whose floor and walls are an inch and a-half thick, is 5 ft. 3 in. long, 3 ft. 7 in. wide, and 2 ft. 5½ in. high, in *external dimensions* ; find the cost of painting the internal surface at 90 cents per square yard.

5. Perform the following operations :—·053407 × ·047126 to six places of decimals ; and 2·569141797 ÷ 7·5284 to five places of decimals. (Ten marks to be allowed if done by the *contracted* method ; 5 marks for correct answer obtained in any other way.)

6. A note for $730, drawn at 90 days and bearing interest at 8 per cent. per annum, is discounted by a broker 45 days before maturity ; what must the broker pay for the note in order to realize 10 per cent. for his money ? (No days grace).

7. A discount (true discount) of $4 was allowed on a bill of $52 that had 8 months to run, and at the same rate a discount of $5 was allowed on a bill of $75 ; how long had the latter bill to run ?

8. A grocer mixed coffee at 28 cents a pound with some of a better kind at 42 cents a pound, and by selling the mixture at 35 cents a pound he gained 15 per cent. on the former and 20 per cent. on the latter ; in what proportion did he mix them ?

9. A vat 4 ft. long, 3 ft. wide and 9 inches deep contains pulp for making paper ; a percentage of the pulp is lost in drying, and a sheet of paper 2700 yards long, 2 ft. 6 in. wide and ·004 of an inch thick, is obtained : what per cent. of the pulp was lost in drying ?

10. Find the area of a trapezoid whose parallel sides are 27·5 and 38·5 chains respectively, and whose other sides are 12·5 and 15·5 chains respectively.

JULY EXAMINATIONS, 1879.

FIRST CLASS TEACHERS.

ARITHMETIC.

J. A. McLellan, M.A., LL.D.

1. Extract the square root of ·000997199881 to six decimal places, and reduce to its simplest form

$$\frac{\sqrt[3]{(3.43)}+\sqrt[3]{(.02744)}}{\sqrt[3]{(270)}-\sqrt[3]{(.08)}}.$$

2. A cistern holding 1299 gallons is filled by 3 taps, *A*, *B*, *C*, in 30 minutes; *A* conveys 10 gallons more than *B* every 2½ minutes, and *C* 8 gallons less than *B* in the same time: how much does each supply per minute?

3. At the English Mint 1869 sovereigns are coined from 40 lbs. Troy of standard gold, which is 22 carats fine, and at the French Mint 155 twenty-franc pieces are coined from 2.2072 lbs. (avoirdupois) of gold 90 per cent. fine. The value of the alloy being neglected, find the number of francs in a sovereign, correct to three places of decimals.

4. Two men form a partnership, *A* contributing $5500 and *B* $4500; it is agreed that each shall receive 7½ per cent. of the profits for managing the business, and that the remainder shall be divided according to the stocks and times of investment; at the end of 10 months *B* puts in $2000 additional capital, but ceases to aid in the management, and agrees that *A* shall thenceforth receive 15 per cent. of the profits for managing the business; at the end of 12 months from the time of starting, the profits are found to be $4000: how much of this should each receive?

5. Log 2 = ·3010300, log 3 = ·4771213, find log of ·0000025.

In how many years will $100 exceed $1000 at 8 per cent. per annum compound interest?

6. A grocer sells coffee at a cash price which is 33⅓ per cent. above cost; he also sells on credit, giving 8 lbs. for what would buy 9 lbs. if paid in cash: how much per cent. above cost is his credit price?

7. Assuming 19 as the specific gravity of gold, and 2·6 as the s.g. of quartz, find the quantity of gold per oz. in a mixture whose s.g. is 7.

8. A dealer purchased on six months' credit, goods to the amount of $520; after keeping them three months he sold them on credit for $577.70, and allowing money to be worth 8 per cent., he found that he had made 16¾ per cent. on the transaction; on what term of credit did he sell the goods?

9. A broker sold a farm for $6000, charging a certain rate of commission, and invested the proceeds less his charges on both transactions in city property, receiving on the latter a commission of 4 per cent. on the price paid; his entire commission was $375: what rate did he charge on the sale of the farm?

10. (i) A field in the form of a sector of a circle has its radius 80 yards, and its angle 112° 30′: find its area and the length of its arc.

(ii) The sides the first and la

JULY EXAMINATIONS, 1879.

SECOND CLASS TEACHERS AND INTERMEDIATE.

J. A. McLellan, M.A., LL.D.

1. (*a*) Divide $84.33\dot{2}47\dot{6}$ by 12.734.

(*b*) The circumference of a circle divided by 3.1415926 gives the diameter nearly; what multiplier of five decimal places may be used instead of this divisor?

2. Show how to find the G.C.M. and the L.C.M. of two or more fractional numbers.

The G.C.M. of two fractional numbers is $\frac{13}{180}$, and their L.C.M. is $34\frac{1}{3}$; one of the numbers is $2\frac{1}{6}$, find the other.

3. Sterling exchange is quoted in Toronto at $109\frac{1}{8}$ for 60-day bills; what must be paid for a 60-day bill for £45 8*s.* 6*d.*?

4. The old wine gallon is 231 cubic inches; the cubic inch is .000016386 cubic metres, and the imperial gallon is 4.54102 litres; how many imperial gallons are there in 157 wine gallons?

5. There are two clocks, one of which loses $3\frac{1}{2}$ minutes a day, and the other gains $3\frac{1}{2}$ minutes a day; the latter marks a time 25 minutes in advance of the former: when will both clocks mark the same time?

6. A person had stock of the Dominion Bank; he received a half-yearly dividend of $4\frac{1}{2}$ per cent., which he invested in the same stock at $113\frac{1}{3}$, and his entire stock was now $16,600; how much stock had he at first?

7. If 5 men earn as much in a day as 8 women, and 2 women as much as 3 boys, and if 7 men, 12 women, and 20 boys earn $205.50 in 6 days, what amount will be earned in 8 days by 6 men, 10 women, and 24 boys?

8. If 12 lbs. avoirdupois of American standard silver, which is 90 per cent. fine, be coined into 175 dollars; and if the value of the alloy be $37\frac{1}{2}$ per cent. of that of pure silver, find the value of one pound Troy of the alloy.

9. A merchant imported 700 yards of silk and marked it to gain, as he supposed, 25 per cent.; but having neglected to take into account a charge of $125 for freight and duty, he made only $6\frac{3}{8}$ per cent. profit: find the invoice price of the silk.

10. (1) How many yards of painting are there in the walls of a room 20 ft. long, 14 ft. 6 in. wide, and 10 ft. 4 in. high, allowing for a fire-place 4 ft. by 4 ft. 4 in., and two windows each 6 ft. by 3 ft. 2 in.?

(2) Find the number of cubic feet in a hollow cylinder, the external circumference of which is 5 ft. 6 in., the internal circumference 3 ft. 8 in., and the length 18 feet.

JULY EXAMINATIONS, 1880.

FIRST CLASS TEACHERS—GRADE C.

J. A. McLELLAN, M.A., LL.D.

1. Prove the rule for multiplying one fraction by another, and deduce that for dividing one fraction by another.

Prove

$$\frac{\underline{|48}}{\underline{|13}\times\underline{|35}}+3.\frac{\underline{|48}}{\underline{|12}\times\underline{|36}}+3.\frac{\underline{|48}}{\underline{|11}\times\underline{|37}}+\frac{\underline{|48}}{\underline{|10}\times\underline{|38}}=\frac{\underline{|51}}{\underline{|13}\times\underline{|38}}$$

2. Show, without algebra, the reasons of the rules for pointing in multiplication and division of decimals.

Reduce to a decimal of four places:

$$\frac{1}{2^2}+\frac{2}{2^3}+\frac{3}{2^4}+\frac{4}{2^5}+\frac{5}{2^6}+\frac{6}{2^7}+\frac{7}{2^8}+\frac{8}{2^9}.$$

3. A rectangular piece of ground contains 9 acres 1 rood 16⅓ poles; its length to its breadth as 3 to 1: find (1) the distance round it, (2) the distance from one corner to the opposite corner.

4. Investigate a rule for finding the amount of an annuity at compound interest for a term of years.

I borrowed $2000 for four years at 10 per cent. compound interest, to be paid in four equal annual payments. Find the annual payment.

5. A piece of glass whose specific gravity is 2·4, and whose weight is 4½ lbs., is found to weigh only 2¼ lbs. when weighed in a certain liquid. Find the s.g. of the liquid.

6. Shew how to find the true discount for a given time and rate.

I bought a bill of goods amounting to $1040, for which I gave my note payable in six months without interest, and immediately sold the goods for $1200 on such terms of credit as made my gain 17½ per cent., reckoning money worth 8 per cent. Find the term of credit,

7. Prove that the area of a circle $= \pi r^2$, or $=$ radius × ½ circumference.

What is the proportionate error in the following rough rule for finding the area of a circle:—Take ¾ of the square on the diameter and add one per cent.

8. A cistern is kept constantly supplied with water; supposing it full, it is found that 24 equal taps opened together will empty it in 5½ minutes, and 15 of them will empty it in 13 minutes. How many of them will empty it in 33 minutes?

9. State the rule for finding the characteristic of the logarithm for any number.

Find the number of digits in the integral part of $3^{20} \times 5^{15} \div 2^{11}$, and the number of ciphers between the decimal point and the first significant figure of the decimal representing 3^{-15}.

10. (1) The base of a triangle is b, and its altitude a, required the distance from the vortex at which a parallel to the base must cut the altitude in order to bisect the triangle.

(2) The perimeter of a right angled triangle is p, and the radius of the inscribed circle is r: determine the sides of the triangle.

JULY EXAMINATIONS, 1880.

SECOND CLASS TEACHERS AND INTERMEDIATE.

J. A. McLELLAN, M.A., LL.D.

1. The G.C.M. of two numbers is 9187, and their L.C.M. is 634938944494 : one of the numbers is 68590142, find the other.

2. (1) Divide 159.982 by .0009840018 to 7 places of decimals.

(2) Reduce $\frac{61}{4649}$ to a periodic decimal.

(3) Reduce $\cdot\dot{7}00245\dot{7}$ to a vulgar fraction.

3. There is a rectangular garden whose length is to its breadth as 6 to 5; running round its outside is a gravelled path 3 yards wide; this path cost, at 18¾ cents per square yard, $127.25. Find the dimensions of the garden.

4. Simplify $\frac{2\sqrt{90}}{3\sqrt{108}} \times \frac{7\sqrt{192}}{5\sqrt{126}} \div \frac{4\sqrt{15}}{15\sqrt{21}}$. Find the mean proportional between 3402 and 15172; and extract the square root of ·000097199881.

5. The oxygen of the air is 3 parts (by volume) in 14 of the whole; 100 cubic inches of air weigh 31 grains, and the weight of oxygen is to that of air as 53 : 48. Find the number of grains of oxygen in a cubic foot of air.

6. *A*, *B*, and *C* do a piece of work; it would have taken *A* 2½ times as long as *B* and *C* together, and *B* 3½ times as long as *A* and *C* together. If they receive $240.40 for the work, how much should each man receive?

7. Assuming that 90 cubic inches of lead, together with 81 cubic inches of cork, are equal in weight to 2308 cubic inches of pine, and that the weights of equal bulks of lead and pine are represented by the numbers 226.48, and 9, respectively; determine the proportionate weight of an equal bulk of cork. 4·8

8. A merchant in Toronto owes £560 stg. in London, and remits as follows: first to Paris at 5 francs 60 centimes per $1; thence to Hamburg at 2 francs per marc; thence to Amsterdam at 17½ stivers per marc; thence to London at 224 stivers per £1. If the expense of this circuitous exchange be 2 per cent. (*i.e.* of $102 paid by the merchant, $2 is lost in commission), find what it costs to discharge the London debt. $2611·20

9. I had two notes whose aggregate face-value was $761.70, and each of which had 15 months to run; one of the notes was discounted at 10 per cent. bank discount, and the other at 10 per cent *true* discount, and the total amount realized was $671.50. Find the face of the note on which *true* discount was allowed. $360·86+

10. A cylindrical silver wire, .0015 millimetre in diameter, weighs 3.2875 grammes; it is to be covered with a layer of gold ·0002 millimetre in thickness. Required the weight of the gold, the specific gravity of silver being 10.47, and that of gold 19.26.

JULY EXAMINATIONS, 1880.

THIRD CLASS TEACHERS.

J. A. McLellan, M.A., LL.D.

1. Examine the statement "Division is a short method of Subtraction." Apply your answer to illustrate the following examples: (1) Divide $48 by $16. (2) Divide $48 by 16. Divide $48 among 16 boys.

2. Explain clearly the principles involved in finding the sum of two fractions.

Simplify

$$\tfrac{1}{3}\left(3\tfrac{1}{5} + 1\tfrac{1}{4}\right) \text{ of } £1 + \tfrac{1}{4} \text{ of } \frac{1\frac{1}{3} - \frac{1}{3} \text{ of } 1\frac{1}{8}}{\frac{1}{10} \text{ of } 3\frac{1}{3} + \frac{4}{9}} \times .95 \text{ of } 5s. + \frac{2.1}{.012}d.$$

3. What is the square of a number? The square root?

Explain why, in extracting the square root of a number, you mark off the number into "periods of two figures each."

Simplify $(3\sqrt{32} - 2\sqrt{28}) \div (\sqrt{32} - \sqrt{28})$.

4. Define *ratio*, *proportion* and *mean proportional*.

The quantity of saline matter in sea-water is $\cdot 036$ of the whole weight, and of this weight $\cdot 06\dot{1}$ is magnesia. Find the number of grains of magnesia in a cubic foot of sea-water, supposing 32 cubic feet of it weigh 2000 lbs.

5. Shew that "Bank" discount exceeds "True" discount by the simple interest on the True discount.

If $6 be allowed as true discount on a bill of $150 having a certain time to run, what would be the discount if the bill had twice as long to run?

6. *A* and *B* form a partnership, *A* supplying 25 per cent. more capital than *B*. At the end of the year *A* withdraws 60 per cent. of his capital, and *B* withdraws 40 per cent. of his; at the end of two years there is a gain of $3383.50 to be divided. How much does each receive?

7. A merchant bought 350 yards of silk and 1470 yards of lustre, the price per yard of the lustre being 30 per cent. that of the silk; he sold the silk at a gain of 35 per cent., and the lustre at a loss of $33\frac{1}{3}$ per cent., and lost on the whole $39.20. Find the cost price of the silk per yard.

8. An agent sold a consignment of flour for $4800, and invested the proceeds (less his commission on both transactions) in the purchase of tea, receiving on the latter purchase 4 per cent. on the amount invested. His commission on both transactions being $300, find his rate of commission on the sale of the flour.

9. Find to six decimal places the average of $2\frac{3}{8}$, 2.37, $3.00\dot{6}$, 0, $2.97\frac{1}{7}$, and $3.\dot{5}1\dot{6}$.

10. There is a garden-plot in the form of a trapezoid, whose two parallel sides are 40 yards and 50 yards respectively, the other sides being respectively 30 yards and 24 yards. Shew that the perpendicular distance between the parallel sides is $\frac{32}{5}\sqrt{11}$.

JULY EXAMINATIONS, 1881.

FIRST CLASS TEACHERS—GRADE C.

1. Examine the merits of the following test of the accuracy of a sum in addition:—"Divide the sum of the digits in each horizontal line by 9, retaining only the remainders; divide the sum of these remainders by 9, and if the remainder then obtained be equal to the remainder obtained on dividing the sum of the digits in the answer by 9, the answer is correct."

Will the test apply if "vertical lines" replace "horizontal lines" in the preceding; and if so, why?

2. A man sells goods for $1125. Half he sold at an advance of 25 per cent. on the cost, two-fifths at an advance of $12\frac{1}{2}$ per cent., and the remainder at half its cost. What did he originally pay for the goods? $1000

3. If 4 pumps, each having a length of stroke of 3 ft. and piston of radius 3 inches, empty a cubical cistern whose side is 6 ft., in 1 hour; what must be the radius of the piston of each of 6 pumps whose stroke is 4 ft., that they may empty a cistern whose sides are half those of the former in $\frac{5}{8}$ of an hour, there being a defect in the latter pumps which takes away 10 per cent. of their efficiency? 1 inch

4. A tax bill for $291.60 may be paid in three instalments—$111.60 on June 25th; $90 on August 4th; and $90 on October 4th. If all be paid on June 25th a reduction is allowed of $\frac{2}{100}$ of the instalments that might have been deferred. What rate per cent. per annum is this allowing for money? $11\frac{293}{1597}$ %

5. A bankrupt's apparent assets are 80 per cent. of his liabilities; but on $20,000 of these assets he recovers only 80 cents on the dollar, and 4 per cent. of the amount the estate actually realizes is consumed in the process of winding it up. He pays 60c. on the dollar; what were his liabilities? $22857 1/7

6. *A* gives *B* $210 on May 11th, and in return takes his note at 5 months, agreeing not to exact interest. On June 11th, *A* sells the note to *C* for $205, and *B* makes good to *A* the $5 so lost. When the note falls due, *C* exacts interest at 7 per cent. per annum. Find the rate per cent. per annum gained, lost or paid by the several parties to this transaction.

7. A municipality whose property is assessed at $1,000,000 borrows $40,000; find an expression for the tax (rate in the dollar) that must be levied to form a sinking fund that will repay this in 10 years, money being worth 6 per cent. per annum, the taxes being levied yearly and money compounded half yearly.

8. The sides of a triangle are 4, 5, 6; find its area.

9. Eight equal spherical iron balls, radius 1 foot, are just enclosed in a cubical box, and the box is then filled up with water. Compare the weights of iron and water in the box, the specific gravity of iron being 7.79.

Give the expression for the surface of a sphere in terms of its radius.

10. Shew how to determine the surface of a right circular cone. The height of a frustrum of such a cone is 3 feet, radius of base 2 feet, and semi-vertical angle 30° ; find its surface. If this surface were made of paper, and being cut from the cone were spread on a flat surface, find the dimensions of the curve formed by what was the bottom edge of the cone.

JULY EXAMINATIONS, 1881.

INTERMEDIATE.

1. Find the L. C. M. of 545, 26487, 1853, 11421.

One kind of brick is $4\frac{1}{2}$ inches long and $2\frac{3}{4}$ high; another 5 inches long and $3\frac{1}{2}$ high. What is the size of the least piece of wall, height being same as length, that can be constructed of either kind of brick.

2. Define the numerator and denominator of a fraction, and from your definitions *prove* that

$$\frac{2}{3} \times 5 = \frac{10}{3}, \quad \frac{2}{3} \times \frac{5}{7} = \frac{10}{21}.$$

3. Simplify

$$\left\{\frac{\frac{2}{15} \text{ of } 11\frac{1}{4} + \frac{2}{17} \text{ of } 7\frac{2}{7}}{33\frac{1}{8} - 6\frac{3}{8}} + 8\frac{7}{16}\right\} \div \left\{\frac{[illegible] \text{ of } 6\frac{3}{4} - 2\frac{1}{8}}{25 + \frac{1}{7} \text{ of } 3\frac{1}{8}}\right\}$$

Add together [illegible] of 1 wk. 2 dys. 17 hrs., [illegible] of 17 hrs. 23 min. 26 sec., and [illegible] of 2 dys.

(Accuracy of result essential in preceding fractions.)

4. Describe briefly the metric system of measures.

If a gallon contain 277 cub. in., and a dekalitre contain 17.6077 pints, express a metre in inches.

5. If *A* walk 7 hours a day, and *B* 6 hours a day, and if, under like conditions, *B* can walk 6 miles while *A* is walking 5, how many days will *A* be walking down hill a distance which *B* accomplishes up hill in 3 days; supposing that a man's rate of walking is increased by one-third in going down hill, and decreased by one-fourth in going up?

6. If 1000 men can excavate a square basin whose side is 1,600 yds., and which is 30 yds. deep, in 9 months, how many will be required to excavate a square basin whose side is 2,000 yds., and which is 40 yds. deep, in 12 months?

7. The hands of a clock move irregularly, the hour hand moving 5 per cent. too fast, and the minute hand 10 per cent. too slow. In 15′ (true time) they will be together; how many minutes, measured on the face of the clock, are they apart now?

8. A money lender has $1,500 out at 8 per cent., $1,200 at $7\frac{1}{2}$, and $1,000 at 6; find the percentage he receives on the average.

9. A mortgage for $1,000, paying 7 per cent. per annum, payable yearly, has two years to run; what should a loan society give for the mortgage that it may receive 8 per cent. on its investment, it being assumed that all moneys received by the society can be lent out at 8 per cent.?

JULY EXAMINATIONS, 1882.

FIRST CLASS TEACHERS—GRADE C.

(All work must be purely Arithmetical.)

1. Explain fully why you double the quotient for a new divisor in extracting the square root of a number; and, what is the meaning of the numbers 30 and 300 which appear in the common method of extracting the cube root.

2. A wine merchant buys a barrel of wine (32 gals.) for $25 and sells it at $1.50 per gallon. The leakage amounts to two-fifths of a gill per day; and his living expenses to $510 per year. How many barrels per year must pass through his hands in order to cover the whole expense of his business?

3. A person buys a horse upon borrowed money for which he pays 6 per cent. per annum. The horse earns 70 cents daily and costs ½ per cent. upon his purchase price for daily keeping. The owner sells him at the end of a year for $50, and realizes $132.40 upon his whole transaction. What did the horse cost?

4. A mortgage drawn March 1st, 1878, for $4000 is to be paid in 8 annual instalments of $500 each, with interest at 4 per cent. per annum. It, having made the payments regularly, is offered for sale on Sept 15th, 1881. What should it bring, money being worth 6 per cent. per annum.

5. Given that 772 pounds raised 1 foot represents the amount of heat required to warm 1 pound of water through 1°F., and that 1°F. is equal to $\frac{5}{9}$°C., and that 39.37 inches is equal to 1 metre, and that a cube of water one-hundredth of a metre upon the edge weighs 1 gram, how many grams raised 1 metre will represent 1 gram of water warmed through 1°C.?

6. A specimen of galena yields 82 per cent. of its weight in lead, and a cube of the lead one-fifth of an inch upon its edge yields a sphere of silver .027 inches in diameter. If the density of the lead be 11.3 and of silver 10.5, and if silver be worth 84 cents per ounce, what value of silver is contained in one ton of galena?

7. A flume is two feet wide at the bottom, 3 feet at the top and 4 feet deep, and it is filled to a height of 2½ feet with water. It supplies a turbine from which the water issues through 12 circular orifices each 1 inch in diameter with a velocity of 12 feet per second. Find the mean velocity per second with which the water moves along the flume.

8. A piece of lead in the form of a prismoid is 3 inches by 4 upon one base and 5 inches by 6 upon the other, and 10 inches high. If it is pressed into the form of a sphere what will be its radius?

JULY EXAMINATIONS 1882.

INTERMEDIATE.

1. The fore and hind wheels of a carriage are 9 and 12 feet in circumference respectively. There are two points, one in each circumference, at present in contact with the ground. Shew that as the carriage moves on these points can never at the same time be the highest points of each wheel.

2. Reduce $\left\{\dfrac{5\frac{1}{5} - \frac{1}{4} \text{ of } 2\frac{2}{7}}{\frac{3}{5} \text{ of } 4\frac{1}{6} + \frac{1}{12}} - \dfrac{859}{1085}\right\}$ of 3 lbs. to the fraction of 5 tons.

3. *Prove* that $.48\dot{7}3\dot{2}$ is equal to $\dfrac{48684}{99900}$.

4. Find the present value of $320.00, due two years hence, at 8 per cent. per annum, compound interest.

5. Find approximately in how many years a given sum of money will double itself at 15 per cent. per annum, compound interest.

6. How large a bill of exchange on Paris can be bought for $1500.00 currency, exchange being at the rate of $1 for 5.25 francs, and gold being at a premium of 8½ per cent.?

7. On July 10th a banker discounts a note for $500.00, made May 10th, at six months, at the rate of 8 per cent. per annum. At what rate does he receive interest on his money?

8. A. sells an article at a certain advance per cent. on the cost to B., who, in turn, at the same advance per cent., disposes of it for $19, finding that he had sold for $13 he would have lost per cent. 1½ of what he now gains per cent. What did A. pay for the article?

9. Equal weights of gold and silver are in value as 20 to 1; and equal volumes are in value as 1284 to 35. A certain volume is composed of equal weights of gold and silver; find how many times more valuable the same volume would be were it composed wholly of gold.

10. The volume of a sphere is found by multiplying the cube of the radius by 4.1888; and the area of a circle by multiplying the square of the radius by 3.1416. Find the area of a circle which by rotating about a diameter will describe a sphere whose volume is one cubic foot.